# DATA FOR ENGINEERING INQUIRIES

A COLLECTION OF FORMS GIVING A SCHEDULE OF PARTICULARS WHICH SHOULD BE INCLUDED IN AN INQUIRY FOR A LARGE NUMBER OF DIFFERENT ENGINEERING ACCESSORIES

FOR CONSULTANTS, ESTIMATING ENGINEERS CONTRACTORS, MERCHANTS AND SALESMEN

BY

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# PREFACE

THE collection of engineering inquiry forms embodied in the present volume represents the accumulation of some 20 years' experience, and as they have proved of immense use and great time-savers in my own work, it was thought that they might prove equally useful to other engineers.

The arrangement of the material is alphabetical throughout and a very complete index has been provided, both of which should greatly facilitate the use of the book.

I take this opportunity of thanking Mr. C. Coucill and Mr. T. Scott for the time and labour they have spent in reading the proofs—work, in a volume of this nature, which is very exacting. I trust all errors have been eliminated, but beg the indulgence of readers should any be found.

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# INTRODUCTION

To save time, avoid unnecessary correspondence, and prevent the firm asked to supply the quotation from working out unnecessary alternative offers, it is extremely important that all the essential information should be sent with the original inquiry.

Every competent engineer may be assumed to be expert in his own line, but owing to the vast territory which engineering now covers, he cannot be expected to be expert in all. However, in the course of his work, there are certain to be many occasions when he is called on to include apparatus in his estimates or tenders for which it will be necessary for him to obtain outside quotations. He is then faced with the dilemma of calling in tenders for material, with which he may not be so conversant as he might wish, and for which he therefore does not feel entirely competent to prepare the necessary inquiries.

There are several ways in which this difficulty might be overcome. The engineer might read the subject up in a general handbook and then send out an inquiry containing what he believed to be all the essential information. Or, should he possess catalogues or other trade literature on the apparatus he requires, he might study these and by their aid prepare his inquiry. Whichever method he employs, the result may or may not be satisfactory, depending on the literature to which he has had access, and the care with which he has studied it. But in either case he will have had to spend a considerable amount of valuable time which might otherwise have been more usefully employed.

For the assistance of such engineers it has been the practice of many of the larger firms for many years to provide printed inquiry forms, dealing with their own manufactures. These, which consist of a series of questions the answers to which will precisely define the apparatus that is to be offered, have not, however, been available in a handy form, and usually have to be specially obtained before sending out the inquiry.

The following collection of data sheets, covering a very wide range of engineering material, has therefore been prepared, with the object of providing a handy reference volume for the use of such engineers as have to deal with a large variety of engineering material. Not only is the range of material covered very large, but it is hoped that the usefulness of the data sheets has been increased by the addition of notes explaining the bearing or enlarging the meaning of the questions included on the data sheet.

All questions of a general character, such as those relating to addresses, delivery dates, terms of payment, etc., have been brought together on a General Data Sheet. These questions apply generally to all types of material, and are mainly non-technical in character. This data sheet has been made very full, as it is intended that it should cover inquiries emanating from abroad, where conditions are often very different from those in England, as well as those from home firms. The unit cost of the steam, gas, or electricity supply available has not been asked for on the data sheets for the individual apparatus, although a knowledge of this factor may often be extremely useful when working out the running costs of an installation, or deciding on the most suitable form of drive to employ. If the choice of drive is left to the manufacturer offering the plant, it is therefore desirable that the unit cost of the different supplies available should also be given with the general data.

In addition, as it will often be found that firms offering material do not as a rule supply more information than they are actually asked to give, a data sheet covering "Data which should be sent with the tender" has been prepared, in order that the engineer may specify what technical data he requires in order to be in a position to compare suitably the competing tenders.

The data sheets have, on the whole, been designed to cover plant of a nature common to several trades, and special plant, such as that required in sugar-making factories or rubber works, etc., has been omitted as not of general interest. Further, the majority of the sheets deal with the component parts only, viz., individual machines, and consequently it may often

be necessary to use more than one sheet when dealing with a large job. However, the individual sheets possess the great advantage of enabling the engineer to ask firms to quote only for material of which they make a speciality, and thus to avoid the addition of unnecessary middleman's profits.

If more than one data sheet is to be employed on the same job, it is very important that the "General Data Sheet," sent with each, should clearly specify the exact extent of each inquiry, in order to avoid overlapping or the omission of important material. When several firms are asked to quote for material required on the same job, it may sometimes be advisable to inform each of the names of the firms who are quoting for the other component parts, so that, where necessary, a suitable interchange of technical information may take place between them.

In order to meet those more restricted inquiries for special plant mentioned above, as well as to obviate the necessity of sending a large number of individual data sheets for the various component parts of the whole plant when this is of considerable size, a data sheet entitled "Complete Factory" has been prepared. It is hoped that the notes on this sheet will make it of sufficient use to meet all special cases.

The data sheets have been simplified as much as possible, and the questions kept down to a minimum. They have been combined to serve several classes of apparatus where questions of a similar nature had to be asked, and where this could be done without ambiguity, such as in the sheets for Gas and Oil Engines, Cranes, Pumps, etc. Separate data sheets could, of course, be made for each sub-class, but this has only been done where the questions have to be asked in a special form such, for instance, as in the case of Vacuum Air Pumps, or where differences in structure occur, such as with a Floating Crane. As, therefore, many of the sheets are omnibus sheets, it should be borne in mind when using them that it may not be necessary to answer all the questions given.

Although the sheets have been made as complete as could be done, it is possible that there are various patterns, such, for

example, as those covered by patents, which require certain special information. Whenever these special points have been known, suitable questions have been included, but it may occur that omissions will be found. These should be rectified as they are noticed.

The standardization of engineering materials has been proceeding at a very rapid rate in all countries during the past few years.

When standard specifications of the British Engineering Standards Association (B.E.S.A.) exist for material dealt with in the following pages, they have been referred to on the appropriate sheet as (B.S.S. No. ——), and as it is to the advantage of all, but particularly to that of the manufacturer and of the customer, full use should be made of them when preparing the inquiry.

In many instances, when the question asks for the type to be specified, the answer is not of very much importance, as very frequently the type is limited by the size of the machine itself. Often, too, where more than one type is available, the manufacturer may make only one of these types, and it is to be expected that he will offer this even should it not be asked for in the inquiry. With certain exceptions, or where the customer has very special reasons for requesting a particular type, the answer to such questions is only of importance when it is necessary to have the new apparatus similar to some already in the customer's possession.

Somewhat similar remarks also apply to questions asking for a preference to be expressed. Unless the customer has very definite wishes, it should be left to the maker to choose what he considers to be the most suitable apparatus to comply with the technical data given.

It will be noticed, when reading through the Notes, that the unit in which the answer to many of the questions should be expressed has been given. There is, however, no need that this unit should be slavishly adhered to, provided that the answer is expressed in some equivalent unit. Thus, pressures may be given in any of the following units, whichever is most suitable for the case in question, lb. or kg. per sq. in., or sq.

mm. abs. or gauge ; inches or cm. W.G. ; ft. or m. head of water. Further, it is extremely important to remember that this book may not be in the hands of the engineer making the tender, and consequently that the unit in which the answer is given on the inquiry should always be stated.

On data sheets for apparatus which has to be driven, there will always be found a question asking for particulars of the nature of the drive desired, and in the note to this question the engineer is requested to state the pressure, temperature, etc. (or system, voltage, and frequency) of the supply of power available. The answer supplied to this question will usually be sufficient for small sizes, up to, say, 100 h.p., but for all more important work it is more satisfactory to enclose a completed data sheet for the type of drive (steam engine, Diesel, or gas engine, steam or water turbine, or electric motor) desired. These remarks will also apply to belt, chain, gear, or rope drives, when these are to be included in the tender with the machine to be driven.

These data sheets may also be used as *aides-mémoire* when ordering material, but in this case all the questions given will not require to be answered. In addition, however, it will be necessary to supply extra information, which, as a general rule, defines the use of the apparatus in relation to other apparatus with which it will be connected.

Thus, for example, in the case of engines, motors, etc., state the direction of rotation required ; on which side of the engine the pulley or coupling will be ; whether the engine will be built on to an existing machine or is to be provided with half coupling or free shaft end ; particulars of any keyway necessary, etc. In the case of all apparatus having pipe connections, state the type of flange to be used ; pitch and diameter of bolt holes required ; and in some instances, where it might not otherwise be clear (ex. steam meter), the diameter of the main into which the apparatus will be built.

Care should also be taken to order all material which will be used together, on the same form, if one firm is supplying all the material concerned, or otherwise to provide cross-references, so that the various manufacturers may take the steps necessary

to ensure that the apparatus eventually supplied can be used together satisfactorily.

It may also be sometimes necessary, when the firm ordering the material is also itself erecting the machinery, to ask for drawings giving details of the foundations required, shaft-end with keyway, etc.

All orders should, of course, contain the price, terms of payment, date of delivery, penalty, etc., agreed upon, and references to any previous correspondence which may have taken place.

When employing these sheets for the purpose of ordering material, full use should be made of the "Model General Conditions of Contract" prepared by the Institution of Electrical Engineers (I.E.E.), and of the "Conditions of Sale" prepared by the British Electrical and Allied Manufacturers' Association (B.E.A.M.A.) and by the Incorporated Municipal Electrical Association (I.M.E.A.), as far as these are applicable.

In preparing the index, the most general description of the apparatus has been chosen, but where other descriptions are sometimes used, or where the apparatus has a special trade name in common use, these have also been included and cross-references provided.

It may also be mentioned that all sub-types, and patterns included under an omnibus data sheet, have also been added to the index. Thus, to the omnibus sheet entitled "Instrument, electrical," there are eight cross-references under ammeter, voltmeter, wattmeter, etc. Only the page number for the suitable data sheet is then given opposite these headings, and the expression "see data sheet for—— " omitted.

It may be necessary, in cases where it is customary to inquire for several pieces of interconnected apparatus at the same time, the apparatus being treated for the purpose in question as more or less indivisible, to look under all of the following headings before the correct data sheet is found: Apparatus, Equipment, Installation, and Plant. The same remarks also apply to measuring instruments where, in addition to looking under the name of the instrument itself, the following headings may also be consulted: Indicator, Instrument, Gauge, Meter, and Recorder.

In spite of the care with which the index has been prepared, it is possible that the name of a piece of apparatus cannot be found, even when every alternative name has been tried. In such a case, it is suggested that a data sheet for an analogous piece of apparatus be used as a guide in preparing the inquiry.

The title of the data sheet has been placed in the index in the following order—first the noun, secondly any word directly modifying the noun, and thirdly any word modifying the group so formed, viz.—

Mill, rolling, electrically driven.
Plant, de-gassing, boiler feed water.

# DATA FOR ENGINEERING INQUIRIES

## GENERAL

1. State the name of the firm requiring the tender.
2. Give the address of this firm.
3. State the address where the material asked for will eventually be erected.
4. Give name and address of the consulting engineer, if one is employed.
5. To whom is the tender to be sent ?
6. What is the latest date by which the tender must be received ?
7. Is a specification issued for the material required ?
8. Must this be strictly adhered to or may alternatives be offered ?
9. Is the installation to be a permanent or temporary one ?
10. Is the price put forward to be final or only approximate ?

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The whole of this information may not be required for any one tender and much of it is often included in the specification when one is used, but it is collected here to bring to mind the main conditions influencing the price.

1. It will here be assumed that this is also the name of the firm who will be responsible for payments.

3. This is very important in the case of all material for abroad.

5. To firm or consulting engineer ?

8. It will often be found that manufacturer's standards do not exactly comply with the specification. May these be offered, (*a*) as well as, or (*b*) in lieu of, the specified material. Standard material will usually be found quite as satisfactory and will generally mean a lower price than if special apparatus has to be built.

10. In the case of large contracts, very often a preliminary tender is required to form a basis for further consideration and calculation. This need not be

11. Will price be the determining consideration in placing the order ?
12. May the price be put forward as a lump sum or must the main items be detailed ?
13. Is the contractor to include for the erection of the plant ?
14. Is the erection to be superintended only, or must the contractor provide unskilled labour and lifting tackle ?
15. Give full particulars of all tests to be carried out on the plant.
16. Are these to be carried out at the works or on site ?

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worked out in such detail as a tender which is to be considered as final. It should always be stated, therefore, which form of tender is required, as it will materially lighten the contractor's work.

11. If not, state what will be the determining factor. For example, reliability, time of delivery, guarantees, willingness of contractor to partly finance the contract, terms of payment, etc. In the case of guarantees, give particulars of any penalty attached to their non-maintenance.

12. Give some idea of the extent to which the prices should be detailed, as this usually necessitates a good deal of extra work for the estimator.

14. In the first case the contractor will only supply a few skilled erectors and will then expect the buyer to supply all unskilled labour, lifting tackle, etc. In the second case, full cost of erection will be carried by the contractor. It is not always possible to rigidly adhere to this distinction, as it will depend, to some extent, on the nature of the material to be delivered. When lifting tackle is to be supplied to the contractor, particulars of it should be given so that he may check the size against the maximum weight to be lifted. The contractor will usually assume the free supply of all water, fuel and light, necessary for him to carry on his work. In the case of erection abroad, when the contractor is to supply unskilled labour, some indication should be given to him of the quantity available, its quality, and whether he is to provide living accommodation or not.

15–16. It is practically impossible to specify in detail what tests should be applied to engineering material in general. But the engineer asking for the tender should call for such tests as he thinks will enable him to check the performance of the equipment with which he is being supplied, and to verify the guarantees and other particulars given by the manufacturer.

In selecting suitable tests, he will be greatly assisted by many of the standard specifications issued by the B.E.S.A., where full particulars of suitable tests, for the class of materials to which the specification applies, are given.

As examples may be quoted B.E.S.A. specification Nos. 153, 155/6, 161, 167–9, 173–184, 209–213, 215, 225/226, 232, 234, 239, 242–5, 249/250. These have been referred to in their appropriate place as B.S.S. No. . . .

Where no specification is available, one for an allied piece of apparatus should be consulted and, by the aid of this, suitable tests specified.

In this connection, assistance might also be obtained from the I.E.E. Wiring Regulations, or from specifications, etc., issued by the Inter-departmental

17. Up to what point is delivery to be included ?
18. What is the longest time which may be allowed for delivery ?
19. Is a penalty attached to the delivery date ? Give particulars.
20. If terms of payment are unusual, give full particulars.
21. Is a complete set of spares to be included in the tender ?
22. Are future extensions to be allowed for ?
23. If the apparatus required is to be a duplicate of existing apparatus, give full particulars of that at present in use.

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Government Committee (set up to co-ordinate the Electrical requirements of the various Government departments) or by the International Electrotechnical Commission (I.E.C.).

When carried out at the works, are these to be made during the course of manufacture, or as final tests just before delivery ? If special tests at works are required, who will bear cost ? If made on site, state nature of load to be provided, who is to provide the necessary instruments, etc., and who is to bear the costs of the tests ? State if tests are to be made at both works and site.

17. (*a*) Free on rail at maker's works.

(*b*) Delivery to another works for erection with other plant. State address of these works.

(*c*) Free on quay or free on board at a port. State which, and for which port.

(*d*) Ditto at a foreign port (i.e. sea freight included).

(*e*) Free on rail at nearest railway station, railway sidings, or purchaser's sidings. State which and name of station.

(*f*) Free into purchasers' premises or on site and unloaded.

(*g*) If insurance is also to be effected, state this fact.

(*h*) If all customs charges are to be cleared, mention this fact (unusual).

When road transport is to be included, it is exceptionally important to give fullest details of the road or route to be used, its condition, maximum axle weight which it will carry, carrying capacity of all bridges, particulars of any fords, and times of year these are flooded, etc. Unless otherwise specified, packing suitable for whichever delivery is required, will be included. However, in the case of machinery for delivery abroad, which is to be delivered to home address or f.o.b., state whether special export packing is to be included.

22. State nature and amount of extension to be allowed for, and whether only space is to be provided or whether certain basic apparatus, such as blank switchboard panels without instruments, cables, etc., are to be provided.

23. Where this is the case give full particulars of the existing machinery ; this should include—

(*a*) Machine type (maker's designation).

(*b*) Number of machine.

24. State name and address of the maker of any machinery to be used in connection with any apparatus included in this tender.
25. Give a résumé of the operating conditions under which the plant will work.
26. Are there any special regulations governing the free choice of the plant to be offered? If so, give full particulars.
27. Are there any limitations to the maximum size of the piece which can be transported or handled?
28. State full extent of the material to be covered by the tender.
29. State the number of articles required.

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(c) Size of machine.
(d) Any other particulars on name plate.
(e) Date original machine was ordered.
(f) Any references to correspondence relating to the machinery in question.

24. This is to enable both manufacturers to get into touch with one another and to choose the conditions, discuss technical points, etc., which will enable them to put forward the best combined tender.

25. Is night and day operation required? Is the trade seasonal? State maximum, minimum, and average annual temperature in ° F., and humidity in per cent, of the climate. State altitude of the site in feet. State whether subject to heavy storms (rain, sleet, sand, dust), high winds, lightning, etc. Is trouble to be expected from white ants, boring beetles, or other destructive insects? Or any other conditions which may necessitate special design. In many instances this information has also been asked for in the different data sheets, but this paragraph is intended to call to mind conditions which will make the use of standard apparatus impossible.

26. Such as police, insurance, Home Office, electricity supply regulations, etc. In the case of transmission lines difficulties over way-leaves, etc.

27. Due to the form of transport which must be used, the size of crane or other lifting tackle available, size of door, tunnel, or shaft through which machinery must be taken, etc. The maximum weight, together with the limiting dimensions, should be given. Wherever possible, send loading gauge limits.

28. It will not be necessary to answer this question when a specification is provided. In other cases where complex plant is required, it is very important to indicate exactly where tender is to start and leave off.

Thus, is tender to start—
(a) At and include boiler plant and accessories.
(b) At and include prime mover and accessories.
(c) At and include generator and accessories.
(d) At and include transmission and accessories.
(e) At and include electric motors and accessories.
(f) At and include machines and accessories.
Are buildings, foundations, belts, ropes, electric wiring, etc., to be included?

## 30. Enclose all necessary dimensioned sketches.

30. The nature of the drawings required has usually been detailed in the data sheet itself. They should be to scale, fully dimensioned, and contain all the necessary information to enable the tender to be completed. Indicate position of all railway sidings, canals, quays, roads, etc., as well as position and capacity of all lifting tackle to be used. The drawings will also be used to check certain information contained in the data sheet, such, for instance, as pipe resistance. As there are nearly always a number of possible alternative arrangements for a given set of plant, the drawings supplied should show the arrangement preferred by the engineer. If this should not happen to be the best possible arrangement, the manufacturer will usually suggest a suitable alternative. The drawings should be as detailed as appears necessary to convey all the information required in the inquiry. The scale chosen should be as large as possible, somewhere about 1 : 100 for rooms, etc., not less than 1 : 500 for small factories, etc., and not less than 1 : 2,500 for plans of site.

# DATA TO BE SUPPLIED WITH TENDER

1. Efficiency of the plant offered.
2. Overload capacity.
3. Temperature rise.
4. Regulation of speed.
5. Cyclic irregularity.

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The whole of this information is not required for every Tender, but whichever data are required should always be specifically asked for, as the estimator, as a general rule, supplies no more information than is requested.

It is, of course, apparent that answers to certain of these questions, Ex. 2-5, 8-17-18, need not be requested if those data are already laid down in a specification.

The British Electrical and Allied Manufacturers Association (B.E.A.M.A.), the Incorporated Municipal Electrical Association (I.M.E.A.), and other associations, have prepared standard forms in which guarantees for certain classes of machinery should be put forward.

Such forms are in existence for turbines, turbo-alternators, condensing plant, cooling towers, rotary converters, transformers, etc.

Full use should be made of these, and manufacturers requested to put forward their guarantee on the lines laid down in these forms.

The manufacturer should, therefore, supply the information requested in one or the other of the following forms—

1. The manner in which the efficiency may be expressed can be any of the following—

(*a*) As a percentage ; boilers, motors, generators, etc.

(*b*) Pounds of steam per h.p. hour, per kW. hour, etc., conditions under which this can be obtained should be stated. Ex.: steam, pressure, temperature, and vacuum.

(*c*) Pounds of steam raised per lb. of coal burnt, or per sq. ft. of heating surface, etc. Again specify conditions, class, size, condition, calorific value of fuel, draught, etc.

(*d*) Pounds of oil or cubic feet of gas per h.p. hour.

(*e*) Depth of cooling zone, for cooling towers.

(*f*) Per cent amount of moisture left in material after treatment.

(*g*) Per cent or weight in grains per cubic foot of dust left in gas after cleaning.

Etc.

Also the tolerance within which this figure is guaranteed should be given.

2. Expressed as a per cent of normal full load output.

3. In ° F., state maximum air temperature allowable. Or state that the machinery complies with certain well-known standard specifications.

4. Usually required for prime movers. It should be expressed as—

± . . . . . per cent variation in speed for a change in load of 25 per cent.

. . . . . . . . per cent increase in speed when full load is suddenly thrown off.

5. Important in the case of parallel running of alternators. Should, however, usually be specified by the engineer.

6. Fly-wheel effect in rotating parts.
7. Runaway speed.
8. Voltage regulation.
9. Normal full load speed.
10. Normal full load h.p. required by machinery.
11. Form of drive required by machines.
12. Any special characteristics.
13. Particulars of any accessories necessary but not supplied by manufacturer.
14. Fully-dimensioned sketch of the apparatus offered.
15. Photographs of the apparatus.
16. References to where similar plant can be seen at work.
17. Weights of the individual apparatus offered.
18. Specification for the calculation of customs duties.
19. Minimum time of delivery which can be given by manufacturer.

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6. Of importance for same reason as given under 5, but also sometimes necessary to know this information in connection with electric drives, such as sugar centrifugals.

7. Should always be asked for in connection with water turbines when intended to drive electric generators, so that latter may be designed to withstand this speed.

8. Should be expressed as the rise in voltage when full load is thrown off the machine suddenly (the generator is assumed to be running under full load at normal speed and normal voltage).

9–11. Should be requested when the electric motor or other prime mover is not to be supplied by the same manufacturer as that supplying the machinery.

12. Such characteristics should always be asked for when of interest to the engineer. They will, of course, depend on the nature of the apparatus. Ex.: In case of boiler it may be of interest to know—

(*a*) Heating surface.
(*b*) Grate area.
(*c*) Water volume.
(*d*) Steam volume, etc.

13. Such, for example, as the amount of brickwork required for boiler settings, etc.

14. To enable space required to be seen and foundations, etc., estimated.

16. Of importance in the case of large contracts and all special machinery, or new improvements or inventions.

17. In the case of apparatus for abroad a shipping specification, i.e. net and gross weights, number and size of all packages should be asked for to enable cost of freight, handling, insurance, etc., to be calculated if this is not already included in tender.

20. Terms of payment.
21. Minimum size of crane or other lifting tackle required to handle plant.
22. What accessories are included in the tender ?
23. What spares are included in the tender ?
24. Tolerances with which any of the above figures are guaranteed.

## ACCUMULATOR, ELECTRIC

1. What type of battery is desired ?
2. State the capacity required from the battery in amp.-hours.
3. Give rating of battery required.
4. What type of container is preferred ?
5. In connection with what work is the battery to be used ?
6. What battery terminal voltage is required ?
7. State method of control used to maintain battery voltage.
8. Give the air temperature of the battery room in ° F. . . . . . Maximum . . . . . . . Minimum . . . . . . . . . . . . . . Average . . . . . . .
9. Is the battery to work on a two- or a three-wire circuit ?
10. What accessories are required ?
11. Enclose a dimensioned sketch showing space available.

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Batteries only are included on this data sheet For charging stations, booster, etc., see separate data sheets.

1. Lead or iron plates.

3. The rating may be ¼, 1, 2, 3, 5, or 10 hours, state the discharge current required at one or other of these ratings. If more than one rating is required, this should be expressed as a per cent of the 5-hour rating which may be taken as standard. The percentages of the 5-hour capacity usually obtained for the other ratings are 26·8 per cent, 60, 76, 86, 100, and 120.

4. Glass or wooden. In latter case whether panel type, solid wall type, or lead lined.

5. Railway work, mine hoisting work, stand-by, etc.

7. State whether end cell or booster control is preferred, or will be used, as case may be.

10. This may include cell testing voltmeter, cell inspecting lamp, hydro meters, acid pump, lead burning apparatus, cell bridging apparatus, spares, etc.

11. Full particulars also should be given of all floor girders, etc., which will carry the weight of the battery.

## ACCUMULATOR, HYDRAULIC

1. State demand from accumulator in gallons per minute. Average......Maximum.......
2. Give duration of maximum demand in minutes.
3. State pressure required at outlet in lb. per sq. in. gauge.
4. Are necessary pumps already available? If so, give particulars.
5. What class of machinery will be supplied?
6. What type of accumulator is desired?
7. Give full particulars of foundations to be used.
8. Enclose dimensioned sketch showing proposed lay-out.

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4. If not available are they to be offered? If so, state form of drive preferred. If steam-engine give steam pressure in lb. per sq. in. abs., steam temperature in ° F., and whether engine is to be condensing or non-condensing; if electric motor, state system, voltage, and frequency of available supply.

5. Hydraulic presses, riveting machines, etc.

6. Self-guiding type or with guiding structure. Also state material which is available for loading, and if this is to be included in offer.

8. Should contain full particulars of piping; position of pumps and machinery.

## ACCUMULATOR, STEAM

1. Give the total amount of exhaust steam passed into accumulator in lb. per hour.
2. What is the maximum length of gap in exhaust steam supply in seconds ?
3. State the total amount of steam to be stored in lb.
4. What is the maximum inlet pressure of exhaust steam to accumulator in lb. per sq. in. absolute ?
5. What is the range of pressure variation allowable during regeneration in lb. per sq. in. absolute ?
6. Give particulars of the intermittent steam supply—
   (*a*) From what source does this steam come ?
   (*b*) State length of working period for each source in seconds.
   (*c*) State average length of stop for each source in seconds.
   (*d*) Give initial steam pressure in lb. per sq. in. absolute and steam temperature in ° F., for each source.

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3. The amount of steam to be stored should be equal to the amount of steam required to bridge the gap in the exhaust steam supply without exceeding the range of pressure allowable, and is given by the rate at which steam is being drawn from the accumulator. Thus, if steam is being drawn from the accumulator at the rate of 35,000 lb. per hour, and a gap of one minute has to be bridged, then the storage capacity should be 580 lb.

6. In describing the sources from which the intermittent steam is obtained full particulars should be given of the type of engine supplying the exhaust, i.e. winding or rolling engine, steam hammers or presses, whether compound or triple expansion. If possible, some indication should be given as to the number of machines likely to be operating at one time, so that the maximum and minimum supply of steam to the accumulator may be approximately gauged. This can best be done by means of the diagram asked for under (*f*), which should show, starting from any arbitrary time, when each machine starts and stops. If possible (*e*) should be answered by supplying continuous indicator diagrams for each source. The following data should also be given for each source, if it is available—

(*a*) Number of cylinders.
(*b*) Stroke and diameter of each cylinder.
(*c*) Speed of engine in r.p.m.
(*d*) Point of stroke at which the steam is cut off in h.p. cylinder.

(*e*) State amount of this steam used per cycle in lb., and per hour in tons.

(*f*) Enclose diagram showing how each machine starts and stops relatively to one another.

7. Enclose dimensioned plan.

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(*e*) In the case of winding engines does the engine run without steam under the action of the load, during any part of the working period?

(*f*) If so, state per cent of working period during which steam is actually being used.

7. This should show position of all engines supplying exhaust steam, size of exhaust pipes used, and proposed position of accumulator and turbine working from it.

## ANALYSIS, FUEL

1. State fuel to be analysed.
2. What is the average size of the fuel as it will be fired ?
3. In the case of gases, state the amount of dust in grains per cu. ft.
4. The chemical analysis should state—
   (*a*) Percentage of C present.
   (*b*) ,, ,, H ,,
   (*c*) ,, ,, O ,,
   (*d*) ,, ,, S ,,
5. The analysis should also give—
   (*e*) Percentage of moisture present.
   (*f*) ,, ,, volatile contents.
   (*g*) ,, ,, ash.
6. What is the melting point of the ash in ° F. ?
7. What is the calorific value in B.Th.U. per lb. ?
8. What quality of coke is produced from the fuel ?

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See B.S.S., No. 209.

1–3. Should be filled in by engineer and sent, together with a representative sample, to the chemist for analysis, who will then answer questions 4–8. The customer should state whether answers to all these questions are required, or to which ; this will depend on the purpose for which the fuel is required.

1. Coal, lignite, peat, coke, oil, etc. Name of mine or district from which it is obtained.

7. In the case of gaseous fuels, this should be in B.Th.U. per cub. ft.

8. Light or dense, open or close grained, etc.

## ANALYSIS, OIL

1. State source and class of oil to be analysed.
2. State for what purpose the oil is to be used.
3. The chemical analysis supplied should state
   - (*a*) Percentage of C present.
   - (*b*) ,, ,, H ,,
   - (*c*) ,, ,, O ,,
   - (*d*) ,, ,, S ,,
   - (*e*) ,, ,, Fe ,,
4. The analysis should also give —
   - (*a*) Percentage of moisture present.
   - (*b*) ,, ,, ash present.
   - (*c*) ,, ,, asphalt present.
   - (*d*) ,, ,, acid present.
   - (*e*) ,, ,, alkali present.
5. The following characteristics may also be asked for if required—
   - (*a*) Flash point in ° F.
   - (*b*) Flame point in ° F.
   - (*c*) "Gumming" coefficient.
   - (*d*) Specific gravity.
   - (*e*) Calorific value in B.Th.U. per lb.

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See B.S.S., Nos. 148, 209, 210.

1. Questions 1 and 2 should be answered by the engineer and sent together with a representative sample to the chemist for testing, who will then supply answers to the other questions. The engineer should state whether answers are required to all these questions and, if not, should clearly specify which information is important.

1. Vegetable, mineral or animal and name of oil, or district from which obtained.

2. Annealing, hardening, lubrication, fuel, cooling transformers, switches, etc., insulation purposes, etc.

5. (*a*), (*b*), (*c*), (*f*), (*i*), (*j*). The chemist should be asked to state method or name of test he has employed.

(*c*) This test is to indicate probable amount of asphaltic or resinous products which may settle out from the oil when in use.. Is very important in the case of transformer oil. Full particulars of the test employed should be given.

(*d*) State temperature at which this is measured. Usually 60° F. If important, the temperature may be specified by the engineer.

(*f*) Viscosity at 50° F. and – 60° F.
(*g*) Specific heat.
(*h*) Coefficient of heat transmission.
(*i*) Dielectric strength.
(*j*) Loss due to evaporation.

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(*f*) The temperature given may be varied. The lower temperature of –60° F. is of importance in case of oil switches for erection in open; –40° F. for transformer oil. The upper temperature is of importance for lubricating oils.

(*i*) Express as volts/mm. or volts/inch. Also state diameter of balls used and distance apart.

(*j*) State per cent loss in weight of the oil after . . . hours (usually 5) continuous heating at a temperature of . . . ° F. (usually 212° F.).

## ANALYSIS, WATER

1. State whether the water is to be softened or purified.
2. Give name of district and source of supply of the water.
3. The analysis asked for should state—
   (*a*) The appearance of the water.
   (*b*) If the water gives a deposit after standing some time, and the colour of this deposit.
   (*c*) The smell of the water.
   (*d*) The taste of the water.
4. It should also give—
   (*a*) Presence of any free gas in the water.
   (*b*) The amount of absorbed gas in grains per gal.
5. It should also state the amount of the following substances present in grains per gal.—
   (*a*) Total amount of solids present, dry at ....° F.
   (*b*) Iron.
   (*c*) Manganese.
   (*d*) Lime (as CaO).
   (*e*) Magnesium (as MgO).
   (*f*) Sulphuric anhydride.

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In sending water to a chemist for analysis, the water should be an *average* sample; should be contained in flasks with new stoppers, which have been thoroughly cleaned out beforehand, and washed out two or three times with the water to be sampled before actually putting the sample into them. Each sample should contain about 2 gals., and should be carefully labelled with full name, address, and suitable references. It should always be stated when sending in a sample whether this represents the worst conditions which occur.

Questions 1–2 are to be answered by engineer, remainder by the chemist.

The customer should state whether all or which of these questions should be answered. This will depend on use to which the water is to be put.

2. River, lake, canal, well, etc.

3. (*a*) Sparkling, dull or coloured, and what colour.

4. (*a*) Carbon dioxide, sulphuretted hydrogen, methane, hydrogen, oxygen, etc.

(*b*) This should be given for each gas, but more particularly for oxygen.

(*g*) Chlorine.
(*h*) Alkalinity (as $CaCO_3$).
(*i*) Acidity.

6. A bacteriological examination may also be required, and the result should be expressed as .... .bacteria of all kinds per c.c., and also state whether there are any disease-producing germs present.

## ARRESTER, LIGHTNING

1. State system, voltage, and frequency of circuit on which arrester will be used.
2. In the case of a single-phase circuit, is one pole earthed ?
3. In the case of three-phase circuits, is the neutral point earthed ?
4. Against what is protection required ?
5. State maximum current which choke coil must carry.
6. What type of arrester is preferred ?
7. State where arrester will be erected.
8. Is arrester to be provided with combined isolating switches ?
9. Give some particulars of the country over which the line runs.
10. Enclose dimensioned sketch showing space available.

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1. Also state type of three-phase circuit, star or delta.
3. If neutral point is earthed through a resistance, give particulars.
4. Static charges, surges, etc.
6. Horn gap, multiple gap, electrolytic, water jet, carborundum multipath, etc. State if to be combined with choke coil or not.
7. Indoors or outdoors, in latter case for mast fixing or on special structure.
9. Some indication as to the frequency of storms, their duration, etc., should be given, as well as the nature of the country, hilly, wooded, high mountains, etc. Is climate hot and very dry ?
10. Is very important in case of horn arresters to prevent arc damaging the surrounding structure, etc.

## BALANCER, STATIC

1. What is the normal full load output of the generator with which it will be used, in kW. ?
2. State normal full load voltage of generator.
3. State speed of generator in r.p.m.
4. Is the generator fitted with slip rings ?
5. What is type of generator ?
6. How many main poles has the generator ?
7. Is the generator fitted with interpoles ?
8. What is the lower pressure required from the balancer ?
9. State the maximum out-of-balance current required.
10. What form of balancer is preferred ?

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The price of the balancer will not include fitting slip rings to the generator unless this is specially requested. In this case state name of the generator and maker.

2. Across outers.
5. Shunt or compound winding.
8. That is, the lower voltage required from outer to third wire.
9. That is, the current flowing in the third main to the balancer tap.
10. Whether open, enclosed, air- or oil-cooled

## BEARING

1. State type of bearing required.
2. State form of bearing required.
3. State maximum load on bearing in lb.
4. State maximum surface speed of shaft at journal in feet per minute.
5. Give diameter of shaft at journal in inches.
6. State length of journal bearing surface in inches.
7. What form of lubrication will be used ?
8. Is a split journal desired ?
9. Is the bearing to be adjustable ?
10. Under what conditions will the bearing be used ?
11. Give full particulars of the load on the machine.
12. Has the bearing to take both vertical and horizontal loads at one time ?
13. Enclose dimensioned sketch showing proposed method of using bearing.

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1. Split or solid journal, ball or roller bearings, the material of which the bearing is to be constructed (cast iron, bronze, white metal, gun-metal, wood, etc.) may also be given if the customer has special wishes, but the choice will, to some extent, depend on the load conditions.

2. Horizontal, vertical, thrust, collar, etc.

7. Grease, oil, by loose oiling ring or oil cup, etc.

10. In a damp atmosphere, subject to chemical fumes, in an atmosphere where there is a lot of lint or dust, etc.

11. Steady, fluctuating or impulsive, subject to vibration, etc.

12. Give particulars of each load (maximum, simultaneous values).

13. If for use in a machine the maximum space which can be given to the bearing should be shown. It will be assumed that design of machine can then be altered to suit bearing chosen. If this is not the case draw attention to the fact.

## BOARD, DISTRIBUTION

1. State type of distribution board required.
2. Give normal current to be carried per way in amps.
3. State number of ways per pole required.
4. State number of poles required.
5. Give particulars of the system on which it will be used.
6. What type of fuse is required ?
7. State whether switches are to be included on the board.
8. Is the board to be mounted or un-mounted ?
9. State type of inlets and outlets required.
10. State any accessories required.
11. Has the board to conform to any regulations ?

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See B.S.S., No. 160.

1. In teak case with glass front, totally enclosed ironclad or with glass face, explosion proof, etc.

5. System, state whether 2, 3, or 4 wire, voltage and frequency.

6. Open type, cartridge, Zed, bridge, porcelain tube, etc., with spring clips or knife jaw, etc.

7. Is not possible in every case. State type of switch preferred, tumbler, knife, etc.

8. i.e. on another teak board. If so, is space to be left for a switch or meter, give size. In the case of large amperages, fuses and switches may be mounted independently on angle iron framework. This should be left to manufacturer.

9. Is the board to be provided with—
(*a*) Bushed inlet and outlet holes.
(*b*) Holes screwed for conduit.
(*c*) Sealing chamber.
In case (*c*) state whether sealing chamber is to be separate from main dis-board, or may be combined with it in one casting. Also give particulars of incoming and outgoing cables, i.e. type, construction, size, etc.

10. Main switch to control the whole board, meter, etc.

11. Such as H.O. or local electricity regulations, etc.

## BOILER

1. State evaporation capacity required in lb. per hr. Average...............Maximum...............
2. State the number of hours the boiler will be required to give the maximum capacity continuously.
3. Give steam pressure required at boiler stop-valve in lb. per sq. in. abs.
4. What is the temperature of the feed water at inlet to boiler in ° F. ?
5. Give particulars of the fuel to be used.
6. State draught available at back of boiler in inches w.g.
7. What type of boiler is desired ?
8. Is a mechanical stoker to be employed ?
9. Is a superheater to be used ?
10. Is an economizer to be used ?
11. Is mechanical draught to be supplied ?
12. Give dimensioned sketch of proposed layout of boiler-houses.
13. What accessories are to be offered with the boiler ?
14. State any special regulations to which boiler must comply.
15. Give particulars of the electric supply available.

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See B.S.S., Nos. 14, 53, 62.

1. From and at 212° F.

4. Particulars of the boiler feed water and its treatment should be given (see water analysis).

5. Class of fuel, coal, coke, wood, oil, gas, etc., size of fuel, calorific value of fuel in B.Th.U. per lb. Chemical analysis.

7. Land or marine, flue or water tube, single or double ended, multitubular, Cornish, Lancashire, Babcock and Wilcox, etc.

8–11. If these are to be quoted for with the boiler, give answers to the relevant questions on the data sheets for these articles.

12. This should show proposed layout or positions of existing boilers, superheaters, economizers, etc., flues fully dimensioned, position of chimney and its dimensions, arrangements for supplying coal and removing ash, etc.

13. Pressure gauge, injector, water gauge, safety valve, low water alarm, densimeter, etc.

14. Insurance Company, local regulations, Board of Trade, Lloyd's, etc.

16. State number of hours boiler will be in continuous operation.

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15–16. Apply only to Electric Boilers. In this case, questions 5, 6, 8, 10, 11 need not be answered.

State system, voltage and frequency, price per kW. hour.

This type of boiler can often be used in paper mills, pulp works, etc., where large quantities of steam are required, but plant is practically shut down over the week-end.

## BOOSTER

1. State system which booster will supply and its voltage.
2. Give amount of out-of-balance current in amps. Maximum... Average.........
3. How is this current supplied ?
4. Give full particulars of D.C. load on which booster works.
5. Give particulars of the generators supplying this load.
6. State number and type of cells in battery to be charged.
7. State capacity of the battery in amp.-hours and its rating.
8. Is the battery to be used for stand-by purposes ?
9. Give charging-current allowable in amps.
10. Give particulars of supply for the motor driving booster set.
11. What type of booster is required ?
12. State accessories required.

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1. D.C., two-wire or three-wire.
3. Describe balancing arrangements used.
4. This should state nature of load (lighting, traction, power), whether steady or fluctuating, minimum, average, and maximum values of the load (in amp). Whenever possible, a copy of the daily load chart should be included with inquiry.
5. State number, type (shunt or compound wound), kW. output (full load), voltage, speed, and prime mover.
7. The rating may be ½, 1, 2, 3, 5, or 10 hour. State the discharge current required at one or other of these ratings.
10. System, voltage, and frequency.
11. Reversible or non-reversible, milking, stationary, or portable.
12. Switchboard (see also data sheet for this). In case of portable sets, the switchboard can be fixed to set if this is desired. Milking cables, state type and length in yards, and form of terminal clips required.

## BOX, CABLE-END, TEE, OR JOINT

1. Give type of cable for which the box is required.
2. What is the section of the conductor in sq. in. ?
3. State diameter in inches over lead casing or bitumen sheath.
4. What type of armouring is used ?
5. Give overall diameter of complete cable in inches.
6. State voltage of supply.
7. Where is the box to be fixed ?
8. Is an end, tee, or junction-box required ?
9. What type of box is required ?
10. Are there any special regulations governing the use of these boxes, where they will be erected ?

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See B.S.S., Nos. 91, 94.

1. Single-, two-, three- or four-core ; concentric ; split conductor ; lead-covered ; etc.

4. Single- or double-tape, single- or double-wire armouring. Give size of wire in S.W.G.

7. If boxes are required for mines this should be stated. In the case of a junction box, is it to be buried in the ground or fixed on a pole or on an inside or outside wall ? If fixed in a vertical run it is assumed that no stress will be thrown on the box due to the weight of the cable suspended below. In the case of a cable-end box, are the leads to come out in the same line as the cable or at right angles, and is the box for indoor or outdoor erection ? Must wiped brass glands be used or can sweated fittings, or copper tape bonds or lead bush bonds be employed ?

9. Disconnecting or non-disconnecting ; linked ; fused ; state type of lid required, whether machined-joint or packed-groove.

10. Give particulars.

For boxes requiring compound, the price should be asked exclusive of compound, but the quantity of compound required per box in lb. and its price per lb. should be given in the quotation.

## BOX, NETWORK, JUNCTION

1. State what type of box is required.
2. System, voltage, and frequency of supply.
3. State number of cables entering and leaving, and their arrangement.
4. How are the cables laid ?
5. Particulars of cables entering the box.
6. Particulars of the cables leaving the box.
7. Give any special regulations to which the boxes must comply.

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See B.S.S., Nos. 91, 94.

1. Disconnecting or non-disconnecting; linked; fused. State type of lid required, whether machined-joint, packed-groove or diving bell, and where lid is to be level with surface, whether for roadway or pavement.

3. A small sketch, showing number of cables entering or leaving each side of the box, should be sent.

4. Solid (give kind of trough and internal dimensions) bare in earth, in conduit (give particulars and dimensions of conduit).

5–6. This should include: type of cable (single-, two, three-core, concentric, etc.); nature of insulation (paper, V.I.R., bitumen, etc.). Nature of protection, lead or without; nature of armouring (wire, single- or double-tape) size of conductors (number of strands and S.W.G.). Diameters over bare cable, lead armouring, and overall.

## BRIDGE

1. State class of bridge required.
2. Of what material is the bridge to be constructed ?
3. State clear span required between abutments in feet.
4. State clear internal width of bridge required in feet.
5. Give maximum load for which bridge is to be designed.
6. Give full particulars of the floor and road design required.
7. Enclose report on the strata over which the bridge will be built.
8. State minimum clearance required, if this is important.
9. If for a river crossing, is the river subject to floods ?
10. Enclose roughly-dimensioned sketch showing obstruction to be crossed, and line of bridge.

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See B.S.S., Nos. 15, 153.

1. Footpath, highway, or railway.

2. Wood, stone, ferro-concrete, steel. The actual design of bridge should be left to the firm who will choose the most economical to suit the specified conditions. In case of a stone bridge, what class of stone is to be used and is a suitable quarry near the site available. State distance from bridge, and whether contractor is to work the quarry and dress the stone.

3. This should be the maximum space required to clear the obstruction. If intermediate supports can be used, mention this fact, and state whether stone, ferro-concrete, or steel supports are preferred.

4. Also state width of pavements and width of roadway required. In case of railway bridge also state gauge.

5. This can be expressed as so many lb. per sq. ft. for foot and highway bridges. In addition to the above, also state for all types of bridges weight of heaviest vehicle in tons and maximum weight per axle in tons which will be allowed to pass over the bridge.

7. This should be very full, and is to enable foundations to be designed. It should not be strictly confined to one spot, but should cover possible alternatives.

8. Measured above rail level, roadway, or average river level, depending on what the bridge is to cross.

9. In this case endeavour to give some indication of the extent of the flood, i.e. height above normal level to which the river may rise, and the suddenness with which it may occur. Enclose a full description of the watershed feeding the river in all cases of important bridges.

10. Must the bridge cross at an angle or is an alternative possible. Indicate alternative on the plan. Contour lines at 10 ft. intervals of surrounding

11. Enclose dimensioned drawing of bridge required.
12. Give particulars of any regulations to which the bridge must conform.

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country should be shown. Show depth of river at bridge measured from some specified datum.

11. Will not, of course, always be possible unless the bridge has been designed by a consulting engineer.

## BRUSH, CARBON

1. What type of brush is required ?
2. State dimensions of brush required in inches.
   Length............ Breadth ..... .....Thickness..........
3. State type and length of pigtail required.
4. Is the brush to be copper coated or plain ?
5. Is it for use with a generator or motor ? Give full particulars of machine.
6. Give particulars of the commutator or slip ring.
7. What brush pressure will be used in lb. per sq. in. ?
8. Does the machine run frequently under overload ?
9. Are the brushes to be set radially, leading, or trailing on the commutator ?
10. Give detailed dimensioned sketch of the brush required.
11. Are the brushes lubricated ? If so, with what lubricant ?
12. What is the present make and grade of brush ?
13. Is sparking experienced with them, if so, under what load conditions ?

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See B.S.S., No. 96.

1. Carbon, graphite, copper, etc.

3. Whether riveted, cemented, or detachable. The length of pigtail should be in inches, and should state how measured (generally from centre to centre of connecting lugs).

5. State whether alternating or continuous current. Give speed, full-load current, full-load voltage, number of poles and name of maker. Also state whether commutating poles are used or not, whether load is steady or fluctuating.

6. State diameter of commutator, length, number of bars, nature of insulating material, and whether slotted or not. If not slotted, has any trouble ever occurred, due to high mica ? In the case of slip rings, what is their diameter and what is their composition ?

9. Also state number of sets of brushes and number of brushes per set.

10. This should be a working drawing to which the brush could be manufactured, if ordered.

11–13. Need only be answered if existing brushes are not giving satisfaction, and it is desired to replace them by a new type.

# BUILDINGS

1. For what purpose is the building required ?
2. State clear length, width, and height to eaves required, in feet.
3. Give particulars of all cranes to be used.
4. State height required from floor to gantry rail, and from gantry rail to roof tie, in feet.
5. What type of wall is desired ?
6. Give particulars of all openings required in walls.
7. State what class of roof is required.
8. What type of roof covering is preferred ?
9. Give particulars of all openings in roof.
10. Give particulars of any partitions to be constructed inside building.
11. State type of floor design required.
12. State load which the floor is to carry, in cwt. per sq. yd.

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See B.S.S., Nos. 15, 40, 41, 58, 59 63, 65, 78, 143, 146, 154.

See also data sheet for heating installation, ventilating installation, air-conditioning installation and dust-removal plant.

1. Workshop, car sheds, power station, etc.

3. This should include type of crane (overhead, jib, mono-rail, etc.), maximum load to be carried, and in case of jib crane at what radius, wheel base of overhead cranes, in feet, and length of run of crane required.

5. Brick, tile, ferro-concrete, steel framework, etc.

6. This should include position, dimensions, and specification of all doors and windows.

7. State type of roof (ridged, curved, etc.), pitch of roof, form of ends (gable, etc.), spacing of principals, type of principal, type of purlin, gutters, and drain pipes, etc., unless choice of these particulars may be left to the estimator.

8. Tile, slate, rubberoid, etc. If the roof is called on to carry any loads other than normal, these should be clearly specified.

9. Should include position, dimensions and specification of all skylights, ventilators, etc.

10. This should state position, construction (tile, wood, brick, etc.), and position, dimensions and specification of all doors and windows in them. If a ceiling is to be constructed, indicate in what portion of the building, and of what material it is to be constructed.

11. This should state height to which it is to be raised above ground level outside, construction (wood, steel, concrete, brick, etc.).

12. When machinery, etc., is to be put in the shop, give full particulars (nature, size, weight, speed, etc., and whether weight is concentrated on small feet or spread over a large area) to enable floor design to be checked. Draw

13. State minimum spacing which may be allowed for any necessary columns, in feet.
14. Is overhead transmission to be used ?
15. Are any internal drains to be provided ? Give particulars.
16. Enclose details of any stairways required.
17. Are extensions to be provided for ? If so, state extent, and on what part of the building they will be required.
18. Give full particulars of strata on which building is to be built.
19. Enclose dimensioned plan and elevation of building desired.

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attention to any plant which is likely to cause trouble, due to vibration. State if any railway track (light or full gauge) will be brought into shop, and indicate on plan. This will not be included in offer, but should be dealt with on separate data sheet. State also whether any openings are required in floor, and give their dimensions Are they to be provided with cover ? State type.

14. This will not be included in tender unless specifically asked for, but girders and columns will have to be designed to carry the stress. State length and diameter of shafting, number of bearings, etc.

15. State position, number, width, and design.

19. The plans and elevations should be as detailed as possible. and should show all doors, windows, skylights, ventilators, fireplaces, etc., position of cranes, partitions and stairways, position of overhead transmission, position of any erection pits, foundations, drains, etc., which are to be included.

## CABLE, ELECTRIC

1. What is the voltage of the system ?
2. Is the neutral point earthed ?
3. What type of cable is desired ?
4. What nature of insulation is preferred ?
5. How is the cable to be armoured ?
6. What form of conductor is desired ?
7. State size of conductor in square inches.
8. What material is required as conductor ?
9. State length of cable required, in yards.
10. For what purpose is the cable to be used ?
11. Is an earth shield to be provided ?

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See B.S.S., Nos. 7, 91, 94.

1. The voltage between phases should be given in A.C. systems.

3. Concentric, one-, two-, three-, or four-core cable.

4. Vulcanized rubber, paper, bitumen, etc.

5. Plain lead, lead jute served, steel tape armoured, steel wire armoured, single or double wires. The tape and wire armourings can be applied to paper-insulated cables without lead covering.

6. Round or sector. If split conductors are required also, state whether round or sector.

8. Copper or aluminium.

9. When long lengths are required, the firm asked to quote should state maximum length of conductor of this size which they can supply in one piece, and they should also quote a price for the necessary junction boxes.

10. Underground transmission, shaft cable, trailing cable, shot-firing cable, etc.

If cable is to be laid in ground, state method to be used, solid in trough, in concrete or tile ducts, direct in ground. Draw attention to the presence of corrosive fluids or earth which is liable to attack either the lead sheathing or the armouring.

## CABLE, TELEPHONE

1. State what type of cable is required.
2. Give size of the conductors in cable.
3. How many pairs per cable are required ?
4. State thickness of lead sheathing required.
5. Give particulars of the type of outer protection preferred.

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1. State whether—
(*a*) Dry core, lead-covered.
(*b*) Impregnated paper, loose, lead-covered.
(*c*) Impregnated paper, solid, lead-covered.
2. Usually expressed as lb. per mile.
4. Usually ca. 0·065 in.

## CABLEWAY

1. State maximum single load to be carried, in tons.
2. Give the maximum span required, in feet.
3. State amount of luffing required, in feet.
4. Give maximum lift of bucket required, in feet.
5. For what purpose is the cableway to be used ?
6. What form of drive is preferred ?
7. State any accessories required.

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1. If it is important, also state amount of material to be moved per eight hours.

3. This should be given as plus or minus . . ft. from upright position of end-mast.

4. From ground-level to top of work.

5. Building, dams, locks, canals, viaducts, docks, etc., or for use in quarries.

6. Steam or electric. If a steam supply is available give steam pressure in lb. per sq. in. and temperature in ° F. If not available, is steam-engine and boiler to be included. In this case give particulars of the fuel to be used. In the case of an electric drive, enclose data sheet for motor and starter or controller.

7. Indicator (showing bucket position), etc.

## CALENDER, PAPER, ELECTRICALLY DRIVEN

1. State number of rolls in the calender.
2. State diameter and length of each roll in feet.
3. What class of material is to be produced from the calender ?
4. If several kinds are to be made, of which kind is the largest quantity to be produced ?
5. State the relative proportions of the different classes of material turned out per annum.
6. Give the paper speed required in feet per min. Maximum............ Minimum ........
7. Give the speed of the shaft to be connected to the motor, corresponding to the above paper speeds, in revs. per min. Maximum .. Minimum ............
8. At what speed in feet per min. will largest amount of work be done ?
9. Between what limits in revs. per min. is the motor speed to be varied ?
10. What "inching-in" speed in revs. per min. is required ?
11. How long will the motor be required to run at this "inching-in" speed in seconds ?
12. Will the machine then be immediately brought up to full speed, or allowed to stand for a short time ?
13. If the latter, state how long it will be allowed to stand in seconds.

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3. Thin or thick paper, cardboard, etc. (give thickness).
6. This refers to the continuous operating speeds, and not to the "inching-in" speed.
9. This also only refers to the continuous operating speeds. Unless special limits are given it will be assumed that the maximum range of speed regulation required will correspond to the maximum and minimum paper speeds given in answer to question 6, with special speed regulation to obtain the "inching-in" speed.

14. State the h.p. required from the motor at the following speeds—
    (*a*) Maximum paper speed.
    (*b*) Minimum paper speed.
    (*c*) "Inching-in" speed.
    (*d*) At speed given in answer to question 8.
15. State system, voltage, and frequency of supply available.
16. Does the supply voltage vary? If so, between what limits?
17. Is any source of power available from which a special dynamo may be driven? If available, give full particulars.
18. Enclose a dimensioned sketch showing proposed layout.

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16. This is exceedingly important, and the answer should be given with precision.

17. State whether the generator drive will be from shafting, or direct from steam-engine, gas engine, water turbine, etc. State speed in revolutions per minute of the driving pulley, and its diameter in feet. Does the speed of the shaft vary and, if so, between what limits? In the case of steam-engine, oil or gas engines, or water turbine, give particulars of the system of governing employed.

18. This should show the position of the drive available for the generator and, in the case of outside power supply, the point of supply with reference to the paper machine, so that the voltage drop between constant supply voltage and motor may be accurately calculated.

## CAPSTAN, ELECTRICALLY DRIVEN

1. State maximum pull to be exerted on rope in lb.
2. State speed of hauling required in feet per min.
3. Is capstan to be capable of giving more than one speed ?
4. Is capstan also to be arranged for hand operation ?
5. Give particulars of electric supply available.
6. What form of controller is preferred ?
7. Where is capstan to be erected ?
8. Enclose dimensioned sketch of layout.

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The plant will consist of a totally-enclosed motor with controller, whole enclosed in suitable box carrying the capstan.

1. If this question cannot be answered, state type of load to be hauled (railway wagon), its gross weight in tons, and give full particulars of the track on which it will be drawn. This should include condition of track, radius of minimum curve, gradient in per cent (in this case, state whether the capstan is to pull load against gradient).

3. Can be arranged to give two speeds when desired. State second speed desired.

5. System, voltage, and frequency.

6. For foot operation or key switch.

7. In building, out-of-door. If near sea, state this fact.

8. This should show proposed position of capstan and all track along which it is to haul loads, particulars of all curves and gradients on this track should be marked on plan. If capstan is to be used for warping vessels, the size of vessel and maximum size of hawser to be used should be stated.

This data sheet may also be used for steam or air-driven capstans if the steam or air pressure in lb. per sq. in. abs., and steam temperature in ° F. are given instead of question 5.

## CHARGER, FURNACE, ELECTRICALLY DRIVEN

1. State maximum net weight of charge to be handled in tons.
2. State total furnace charge in tons.
3. Give dimensions of furnace door in feet.
4. State internal dimensions of furnace in feet.
5. State height of bottom of furnace door measured from ground in feet.
6. Is charger to be carried by crane or to run on its own track ?
7. In the former case, state span of gantry rails in feet, and height of rails from ground.
8. In the latter case, state rail gauge, and give particulars of rail section.
9. How are the loaded boxes fed to the charger ?
10. Give dimensions and weight of the charging-boxes used.
11. Give particulars of the electric supply available.
12. Enclose fully-dimensioned sketch of furnace house.

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4. Give width and height.

9. Are they dumped on a stand outside furnace house by a crane from the dump, or are they brought into furnace house on tracks ? State whether the charger is to be capable of revolving round a vertical axis.

11. System, voltage, and frequency.

12. This should be a fully-dimensioned plan and elevation, showing position of furnace and its clearances from wall and roof. Any apparatus, such as gas pipes, hand wheels, furnace door operating gear, which might limit travel of charger should be indicated.

## CHIMNEY

1. What type of chimney is required ?
2. With what plant is the chimney to be used ?
3. State weight of gas to be dealt with at base of chimney in pounds. Average...... .... Maximum .. . . ...
4. Give the temperature of the gases at base of chimney in ° F. Average .. .. Minimum .............
5. What draught is required at the base of the chimney, in inches w.g. ?
6. Is mechanical or hand firing employed ?
7. Is artificial draught supplied ?
8. At what point is this draught applied ?
9. What draught does it create at this point in inches w.g. ?
10. What weight of air does the fan supply in lb. per hour ?
11. Is this fan used only to meet maximum demand ?
12. Is there any statutory limit to the minimum permissible height of chimney ? State minimum height allowable in feet.
13. State to what extent chimney is to be lined with firebrick.

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See B.S.S., No. 41.

If the size of the chimney has already been calculated, then give—
(*a*) Height of chimney in feet from top surface of foundation.
(*b*) Internal diameter at base in feet.
(*c*) Sketch showing proposed design, and as well answer questions 1, 2, 4, 13, 14, and 15.

1. Brick, concrete, steel (self-supporting or with guy ropes).
2. Boiler, blast furnace, Siemens Martin furnace, etc.
3. If this is unknown, state average and maximum amount of coal burnt in tons per hour, particulars of coal (i.e. calorific value in B.Th.U. per lb. and composition), and number of boilers, etc., in operation when firing average and maximum output.
6. Give particulars of the system of mechanical stokers employed.
13. Express as a percentage of the height to be lined, ordinary boiler chimneys usually to ca. two-thirds of height, steel-work chimney usually full height.

14. Give particulars of the site for the chimney.
15. Enclose dimensioned drawing showing layout of all plant.

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14. These particulars refer to soil for foundations.
15. Should show size of each boiler, superheater, economizer, length and areas of flues, etc.

## CLEANER, SOOT (FOR WATER TUBE BOILER)

1. State boiler pressure in lb. per sq. in. abs. and steam temperature in ° F.
2. Give the width of the alley space at side of boiler in feet.
3. Is the boiler setting steel covered ?
4. State the diameter and length of boiler tube.
5. State the number of tubes in the boiler width.
6. Are the baffles horizontal or vertical ?
7. Give space in inches between each tube.
8. Are superheaters installed ?
9. Give particulars of the fuel used in the boiler.
10. How is the boiler fired ?
11. At what rating is the boiler worked ? Average .... .... Maximum ..
12. State make of boiler, type, and size.

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9. This should state whether coal, lignite, oil fuel, etc., class of fuel, size of fuel, and name of mine or chemical analysis of fuel.

10. Hand or mechanically ? If the latter, state make of stoker used.

## CLUTCH, FRICTION

1. State maximum continuous h.p. to be transmitted.
2. State maximum percentage variation of the load from continuous full load.
3. What is the nature of the load ?
4. State normal full load speed in revs. per min.
5. State maximum percentage variation of speed from full load speed.
6. Is the clutch to automatically pick up the load at a pre-determined speed ?
7. If so, at what speed ?
8. Give diameter of shafts on which clutch will be fixed.
9. State voltage of continuous current supply available.
10. Is the clutch required for reversible work ?
11. Does the clutch remain out of use for considerable periods ?
12. State approximate number of times the clutch will be operated per hour.
13. Is the clutch to be supplied in the form of a pulley ?

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2. $\pm$..........per cent.
3. State type of machine to be driven, or whether load is steady, fluctuating, or impulsive.
5. $\pm$...........per cent.
7. Express as a percentage of speed given to question 4.
9. Need only be answered when a magnetic clutch is desired.
11. State longest continuous period out of use, and which half of the clutch is idle.
12. If not operated very frequently give approximate number of operations per eight-hour day.
13. State what form of pulley, rope, belt, chain, gear, etc., is required; diameter and breadth of pulley and particulars of groove, teeth, etc., should be given.

## COMPRESSOR, GAS

1. What is the quantity of free gas to be compressed in cu. ft. per min. ? Normal ..... Maximum.......
2. Give full particulars of the gas to be compressed.
3. What is the gas pressure required at compressor outlet in lb. per sq. in. abs. Normal. . . Maximum.
4. What is the gas pressure at the inlet to compressor in lb. per sq. in. abs. ?
5. What is the gas temperature at compressor inlet in ° F. ?
6. What is the maximum permissible gas temperature at compressor outlet in ° F. ?
7. Is the quantity of gas delivered to be varied ? If so, how often, for how long, and between what limits ?
8. Is the pressure of the gas delivered to be varied ? If so, how often, for how long, and between what limits ?
9. Must the compressor be started against pressure ?
10. Will the compressor feed into a common main fed by other compressors ? If so, give full particulars of other compressors.

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2. This includes the name of the gas, i.e. air, coal gas, chlorine, etc., its average volumetric analysis and its density in lb. per cub. ft. at 760 mm. and 60° F., or specific gravity.

4. When the gas pressure at the compressor inlet is other than atmospheric pressure it should be remembered that question 1 calls for the quantity of gas at atmospheric pressure. If the quantity of gas to be compressed is given at the pressure at the compressor inlet, this should be clearly indicated when answering question 1.

If the compressor is to be used anywhere but at sea-level, the altitude in feet and average air temperature in ° F. of the place at which it is to be used should be given, in addition to the answer to this question.

7–8. If possible, a chart showing the daily or hourly variations of the output from the compressor should be included with the inquiry. If this is not possible, state if the maximum quantity is required throughout the range of pressures specified. If not, state what volumes of air are required at the various pressures.

10. If the compressor delivers into a common main, particulars of the piping, length, diameter, variation in diameter and size and type of compressors

11. Is clean water available for cooling the compressor ?
12. If so, state quantity in galls. per min., temperature of water in ° F., and head in feet available at compressor inlet flange.
13. What type of compressor is desired ?
14. How is the compressor to be driven ?
15. Is the compressor to be started automatically or by hand ?
16. How is the automatic starter to be operated ?
17. For what class of work will the compressor be used ?

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together with number delivering into main at one time and quantity of gas each is delivering should be given.

13. Reciprocating or rotating compressors, fan blowers, roots blowers, centrifugal compressors, etc. Fan blowers may be used for small quantities up to ca. $\frac{3}{4}$ lb. per sq. in., positive pressure blowers (roots blower) up to ca. 50 lb. per sq. in., reciprocating compressors for moderate quantities from 15 lb. per sq. in. and upwards, and centrifugal compressors for large quantities and all pressures.

14. If to be driven from transmission, state speed of latter in r.p.m. and maximum permissible diameter for pulley. Or state what type of prime mover is preferred, gas or steam-engine, turbine or electric motor, and enclose a data sheet with answers to relevant questions. If the compressor maker is also to supply prime mover.

If the prime mover is not to be supplied, state whether a combined bedplate is to be included in offer. In which case, state height of the centre of the prime mover shaft from the underside of its sole-plate in feet, and the type of coupling to be used, solid (is compressor maker to include coupling ?), flexible, etc.

16. This may be done by difference in pressure through pressure switches. In such cases give the range of pressure available to operate the switches.

17. Steel-works, general purposes, etc. If compressor is to run for long periods on end, state length of longest period in hours.

## CONDENSER, STATIC

1. For what purpose is the condenser required ?
2. What output is required from the condenser, in kVA.?
3. What is the present load on the circuit in kVA. ?
4. Give power-factor of this load.
5. To what extent shall this power-factor be improved ?
6. State system, voltage, and frequency of supply at station.
7. What is the voltage at the point where the condenser will be connected ?
8. Give particulars of situation in which condenser will be erected.

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1. State whether for power factor correction or surge protection. In latter case, this data sheet is unsuitable, the questions asked under data sheet for power reactance should be answered instead.

2. If it is not possible to definitely answer this question, give full particulars of the motor or circuit whose P.F. it is desired to improve.

These particulars should include type of motor (single-phase induction motor, commutator motor, etc.), h.p. ; full load P.F. average load on motor in h.p., nature of load, speed.

In the case of a circuit, similar information for all apparatus on the circuit should be given as well as average kW. taken by the whole circuit, as asked for in question 3.

5. Say, from . P.F. to 0·9 P.F., or whatever figure is desired.

# CONDENSER, STEAM

1. State the quantity of steam to be condensed in lb. per hr. Average.... Maximum.
2. What percentage vacuum is to be maintained at the turbine exhaust when dealing with the average quantity of steam ?
3. Is this vacuum to be maintained when dealing with the maximum quantity of steam ?
4. What is the temperature of the cooling water in ° F. ? Mean annual... Maximum......
5. What quantity of cooling water is available in galls. per hr. ?
6. Give particulars of the cooling water available.
7. What type of condenser is required ?
8. How are the auxiliaries to be driven ?
9. Against what total head is the condensate to be pumped ?

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See B.S.S., No. 3,000.

1. State also for how long the maximum demand may last in hours.

2. The vacuum should be expressed as a percentage, but it may also be given in inches of mercury referred to a 30-in. barometer.

3. If the vacuum is to be maintained on maximum load a greater quantity of cooling water will require to be pumped through the condenser, or a more liberally designed condenser employed (in which case a higher vacuum than asked for would be obtained on average load). Which method is the better will depend on the duration of the overload.

5. If quantity of cooling water is limited is a cooling tower to be offered ? If so, send in complete data sheet for the type of cooling plant preferred.

6. State where the cooling water is obtained, i.e. well, spring, river, sea, canal, etc. It is also very important to state whether the water is clean, hard or soft, acid or alkaline. Should there be any doubt on these points, a chemical analysis of the water should be sent. If the water is recooled after use, state type of cooler used. In this case the above particulars refer to the make-up water.

7. This may be surface, jet, barometic, evaporative, ejector, etc.

8. Are the auxiliaries to be separately driven, or may they be combined on one shaft with their prime mover ? Are they to be driven by a steam engine, turbine, or electric motor ? If the prime mover is also to be offered by the condenser maker send in a completed data sheet for the type of prime mover desired, containing answers to all questions applicable to the case in question.

9. The figure given is to include the friction head.

10. Is the condenser to work with reciprocating engines or turbines ?

11. Give a dimensioned sketch showing the proposed layout of the plant.

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11. This sketch, which is extremely important in order to enable the head against which the water must be pumped to be calculated, should show the proposed position of the turbine, condenser, auxiliaries, cooling tower, hot-well, etc., together with the distances between them and the proposed sizes of pipes to be used. It is necessary to have the dimensions which will enable the total lengths of piping to be obtained, and also all bends, etc., must be shown, so that total pipe resistance against which the auxiliaries have to work may be calculated. If on any part of the work existing water pipes have to be used, their length, diameter, number of bends and maximum quantity of water flowing in them at the present moment must also be given.

If the level of the water in the pond or container from which the circulating water is pumped varies at different times of the year, the lowest water-level should be given in addition to the average value.

If the condenser is not fixed immediately below the turbine, particulars of the exhaust piping, must be given to enable the drop in vacuum in this piping to be calculated. The sketch should also show space actually available for the condenser itself.

## CONDENSER, SYNCHRONOUS

1. What is the present load in kVA., on the transmission line ?
2. What is the power-factor of this load ?
3. What is the voltage at the station and at the end of the line, or where condenser is to be connected ?
4. To what extent shall the power-factor be improved?
5. Give particulars of station equipment.
6. How many of these machines are in reserve, and what is their combined output in reserve ?
7. Is D.C. continuously available for the excitation, and, if so, what is the voltage ?
8. What output is required from the condenser in b.h.p. ?
9. State speed of condenser required in revs. per minute.
10. Describe load on the condenser.
11. How is the condenser connected to its load ?
12. Can condenser start up under no load ? If not, state starting torque required.

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See B.S.S., Nos. 168, 169, 226.

4. The power factor may be brought up to unity or beyond if desired, but the greater the amount of correction the larger will be the unit. Instead of stating the improvement in power factor required, the output from the condenser in kVA., may be given.

5. These particulars should include the number, type (i.e. steam turbine, steam engine, gas or oil engines, water turbine), normal full load output in kVA., and speed in r.p.m., of each unit, as well as the total nominal output in kVA. of the station when all the machines are running under full load. If there is a possibility of the power factor being improved in the near future by the addition of new load, the extent of this improvement and when it may be expected should be mentioned.

8–12. These only apply when the condenser, which is here assumed to be a synchronous motor, is also to be used to drive machinery in addition to its duty of power factor correction.

10. Full particulars of the machines to be driven by the condenser should be given. In describing the load particular stress should be laid on the constancy of the load. If the load is variable the extent of its variation expressed as a per cent of the full load on the condenser, and its suddenness, should be indicated.

11. By solid or flexible coupling, belt, rope or chain drive.

12. If possible, the motor should be run up without load, and means should be provided in the machine to be driven to enable this to be done.

13. Where is the condenser to be connected to the line? If at some distance from station, give distance in yards.
14. In the latter case, does the line feed the condenser only, or is there other load on the line as well? If so, state the amount of additional load in kW. and its power-factor.
15. State temperature rise permissible.
16. State system and frequency of supply.

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13. This may be at the central station or very near thereto, or at a considerable distance from it. The answer to this question is of considerable importance when rotary converters are to be used as condensers, and in this case, in addition to the information asked for above, it is also necessary to include the information asked for under rotary converters. If the converter is used in connection with others, the number of converters, the output of each, and the number of machines kept in reserve, should be given.

## CONTROLLER, MOTOR

1. With what type of motor is the controller to be used ?
2. State rated output from the motor in b.h.p.
3. Give particulars of the load on the motor.
4. Against what torque must the motor be started ?
5. State number of times per hour that the controller must be operated.
6. State in what time the motor must come up to speed in seconds.
7. Where will the controller be erected ?
8. Give particulars of supply on which motor is used.
9. Give particulars of motor rotor.
10. Is speed regulation required ? If so, state normal full load speed of motor, give range of speed required, and state how it is to be obtained.
11. Is a reversible controller required ?
12. Is rheostatic braking to be employed ?

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See B.S.S., Nos. 117, 118, 123.

1. Shunt, series, compound or slip ring.

2. Also state rating, i.e. whether continuous, 30, 40, 60, or 90 minute rating.

3. State nature of drive, rope, belt, chain, direct-coupled, and what motor drives crane (state where crane is used ; stripper crane, etc.), charging machine, live rolls, skids, haulage gear, winch, tramway, machine tool (state type and class of work done on it), etc.

4. Express as so many times full-load torque.

6. Usually this question is only of importance when heavy fly-wheels have to be started up. Has a considerable effect on the dimensioning of the resistances. It is assumed that continuous operation is required. If controller is only occasionally used, state number of starts one after the other and length of pause till next group of starts.

7. Give particulars of surroundings, dry, damp, above ground, in mine (is mine gassy), etc.

8. System, voltage, and frequency (if voltage is variable, state range).

9. State whether rotor is two- or three-phase wound, how it is connected, rotor voltage at standstill and rotor current at full load.

10. Is speed variation to be obtained by field and armature regulations ? State range as plus per cent or minus per cent from normal full-load speed, plus will then be assumed as field and minus as armature regulation. State shunt field current of the motor at normal speed and maximum speed required.

11. In case of some crane motors the controller has power and braking contacts one way, free lowering and power lowering the reverse way.

13. Is the controller to have oil-immersed contacts ?
14. State rating of resistances to be employed.
15. State type of resistance preferred.
16. Are brake magnets to be employed ? If so, state type.
17. State type of operating gear to be employed.
18. In the case of a liquid controller, give particulars of cooling water available.
19. Give details of any special fittings to be attached to controller.
20. Give particulars of any safety attachments to be employed.
21. Are there any special regulations to which the controller must conform ?
22. Sketch showing space available for controller, resistances, etc.

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14. Should be left to the manufacturer unless question of spares, etc., requires a particular type to be chosen, as the rating is fixed by the work the motor does.

15. Open, protected, totally enclosed.

16. Shunt, series, etc., totally enclosed, etc.

17. Crank or lever handle, hand or rope wheel, all can be fitted with spring return if required.

Universal lever (in which two controllers are operated by one lever).

18. State source, nature (clean, corrosive, etc.), and average temperature in ° F.

19. Stator switch to be added, cable lugs, cable-end boxes, ammeter, etc., trips can be fitted to some types of controller, but it is very unusual and they should be on main stator switch.

20. Such as limit travel switches for cranes, centrifugal speed limit switches, etc.

21. Such as H.O. regulations for use in mines.

## CONTROLLER, CONTACTOR TYPE

*Answer all questions on data sheet for motor controller, and add following information.*

23. How are contactors to be operated ?
24. How are contactors to be reset ?
25. State number of steps wanted on master controller if used.
26. State special attachments desired.

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See B.S.S., Nos. 129, 155.

23. By master controller, pressure switch, float switch, push button, etc.
24. Hand or electrical resetting.
26. Contactor panels can be fitted with trips ; state type of trip and overload, with or without time lag (state maximum overload setting required), no voltage, racing; only used on D.C. series motors (state percentage of full-load speed at which trip is to act).

## CONVERTER, ROTARY

1. Output required from the D.C. side in kW.
2. Full-load voltage required on D.C. side.
3. System, voltage, and frequency of A.C. side.
4. Is the A.C. voltage constant ?
5. What prime movers are used for driving the generators giving the A.C. supply ?
6. What is the shape of the wave form ?
7. What is the nature of the D.C. voltage ?
8. What amount of regulation is required for D.C. voltage ?
9. Is a shunt or a compound wound converter required ?
10. Will the converter supply a three-wire D.C. system ? If so, state load in neutral.
11. Is the converter required to work in parallel with other machines on the D.C. side ?

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4. If the A.C. voltage is not constant, within what limits does it vary and are the variations sudden and frequent or of long duration ? Is this voltage variation to be dealt with by field regulation or tappings on the transformer ?

5. These may be steam or water turbines, steam, gas, or oil engines. In the case of steam-engines, state speed and cyclic irregularity, and in case of gas or oil engines, speed, number of impulses per revolution and fly-wheel effect in $ft.^2$ tons for each prime mover and generator combined.

6. This need only be given if the wave form departs widely from sine form.

7. This may be lighting, power, electrolytic, traction, etc. Are the load variations sudden or can they be taken care of by hand regulation. If they are sudden, give their size as a percentage of the output from the required converter.

8. If the converter is supplying a pure power load and not working in parallel with other machines, special regulation need not be provided, but there will be a voltage drop from no load to full load of ca. 4 per cent. Should this not be permissible, voltage regulation up to ca. $\pm$ 5 per cent can be provided by means of a shunt regulator in conjunction with a choking coil. If a larger range is required a regulating transformer will be necessary.

9. If the converter is to be provided with a compound winding, is this to keep the voltage constant from no load to full load or to overcompound ? State the extent of overcompounding when required, which should not exceed 10 per cent.

10. The load in the neutral wire should be expressed as a percentage of that in the outer lines, and should not exceed 15 per cent.

11. State the type of machine, whether generator or converter, shunt or compound wound. Give size in kW., and amount of compounding for each machine.

12. How is the converter to be started ?
13. Will the converter also be required to convert D.C. into A.C.
14. State overload capacity required.
15. State maximum temperature rise allowable.

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12. The converter may be started from the D.C. side by means of a starter, or from the A.C. side by tappings from the transformer or by means of a starting motor. State which method is preferred.

13. If the unit is required to run inverted only it will be necessary to know—

(*a*) If the A.C. side is to run in parallel with other machines, and particulars of these machines and their prime movers.

(*b*) The A.C. output required in kW. at a given power factor. The D.C. output asked for under question 1 should then not be stated.

(*c*) Whether the A.C. load is constant or subject to sudden variations.

(*d*) Whether the D.C. voltage is constant. If not, give limits within which it varies. State whether special means are to be provided to maintain the A.C. voltage constant with varying D.C. voltage.

If the unit is for reversible running, the output on either the A.C. or the D.C. side, whichever is most important, should be stated, but not both. All information, including that asked for under question 13, will in this case be required.

## CONVEYOR

1. State the average quantity of material to be dealt with in lb. per hr.
2. Give a description of the material to be handled.
3. Is a horizontal or inclined conveyor required ?
4. If inclined, state the angle of inclination to the horizontal.
5. State maximum total distance in feet through which material must be lifted.
6. State total length of conveyor in feet.
7. What type of conveyor is desired ?
8. How will the material be fed to the conveyor ?
9. Is the feed constant or intermittent ?
10. If the latter, give the maximum quantity of material to be dealt with in pounds, and the time in which the material must be cleared in minutes.
11. Is material to be delivered at the end of the conveyor only, or at intermediate points as well ?
12. In the latter case, give distances of the intermediate discharging points, measured from the feeding point, in feet.
13. How is the conveyor to be driven ?

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2. This should state name of material, coal, ash, clay, iron ore, grain, boxes, sacks, etc. ; whether wet (give per cent moisture) or dry ; weight in lb. per cub. ft. ; and weight of the largest piece likely to be handled ; has it any corrosive action ; temperature of material as fed to conveyor in ° F.

3. If the inclination to the horizontal is not the same throughout the length of the conveyor, the length of conveyor for each inclination must be given, and the dimensioned sketch should show how these stand in relation to one another.

6. Measured along conveyor.

7. Band, worm or screw, tray, roller, pneumatic, etc., open or protected, and if the latter whether steel or wooden protection. In case of band conveyor, state what type of belt is preferred.

10. Will fix the maximum capacity of the conveyor.

13. Usually this will be from some existing line shaft. In which case the speed, diameter of pulley, direction of rotation and position relative to the conveyor of the proposed drive, should be given. If electric drive is desired the system, voltage, and frequency of the supply available should be stated. If gravity only is to be used, state this fact.

14. Will the conveyor work in a deleterious atmosphere ?

15. Give a dimensioned sketch showing proposed layout.

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14. This should state whether the conveyor is to work in a hot or damp atmosphere, etc. Is conveyor to work in open air or under cover ?

15. Plan and elevation required. These should show feeding point as well as all points where material is to be charged. In the case of a pneumatic system collecting material from more than one point simultaneously (such, for example, as collecting wood shavings for several wood-working machines), each point must be clearly indicated on plan.

## COOLER, AIR

1. State quantity of air to be cooled in cu. ft. per min.
2. Give temperature of air at cooler inlet in ° F.
   Average annual . . Maximum . . Minimum . . ..
3. State humidity of air as a percentage. Average annual . . .. Minimum . .
4. State cold air temperature required, ° F.
5. Give particulars of fresh water supply available.
6. Is it also desired to dry air ? If so, state percentage humidity of dry air desired.
7. Is it also desired to clean the air ?
8. Describe purpose for which air will be used.
9. Enclose dimensioned sketch showing space available for cooler.

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Can also be used for data sheet for air dryer or conditioning plant, and for other gases than air. When used for other gases than air, give full particulars of the gas.

2–3. Whenever possible, supply charts for an average year.

4. When very cold air is required it may be necessary to use refrigerating plant. If such should be the case is refrigerating plant to be offered ? If so, supply completed data sheet.

5. This should state source of water, well, spring, river, mains, etc., temperature ° F., average annual and maximum, pressure at cooler in inches w.g., and quantity in gallons per hour.

7. If so, supply data sheet on air filter or gas cleaning plant, whichever is the most applicable to the case in question.

8. For conditioning air in textile mills, chemical works, explosive factories, cooling air for generators, air for blast furnaces, etc.

## COOLER, OIL

1. State quantity of oil to be cooled in galls. per hr.
2. State temperature of the oil at cooler inlet in ° F.
3. Give temperature to which the oil has to be cooled in ° F.
4. Give particulars of the cooling water available.
5. For what purposes is the oil used ?
6. Is a circulating pump for the oil to be included ?
7. What form of drive for the pump is desired ?
8. Enclose dimensioned drawing of site for cooler.

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4. Source, river, well, mains, etc., pressure at cooler in inches w.g., average temperature in ° F. and quantity available in gallons per hour.

5. Lubricating bearings (state what class of machinery), quenching baths for the heat treatment of steel.

7. Usually only transmission and electric drive come into question. State which, give speed of transmission shaft, or system, voltage and frequency of supply.

8. This should show proposed position of cooler, pump, and drive, size of all piping (which will not be included unless specifically asked for).

## COUPLING, FLEXIBLE

1. State h.p. to be transmitted by coupling. Average Maximum . .
2. Is the load steady or fluctuating ?
3. If the latter, give the approximate maximum fluctuation as a percentage of the normal load.
4. State normal working speed in revs. per min.
5. If speed is variable, give the limits within which it varies.
6. In the case of speed regulation, is the h.p. or the torque to be maintained constant throughout the range of speed ?
7. Is the overload given under 3 likely to occur at all speeds within the range given under 5 ?
8. If not, state speed at which overload will occur.
9. Give particulars of the machine to be driven through the coupling.
10. Give diameter of both shafts, if these are abnormal.
11. Is machine reversible ?
12. Is coupling to be insulating ?

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3. This may also be given as so many times normal load.

5. This should give range of speed . r.p.m. to r.p.m. when the range is large, or | r.p.m. for a small variation.

11. It will be assumed that load in the reverse direction is the same as given in question 1, unless otherwise stated.

## CRANE

1. State the load to be lifted in tons. Maximum........
2. State any particular speeds of operation required, in ft. per min.—
   - Travelling . . .. . . . .
   - Slewing or traversing. ....
   - Lifting max. load. . . . .
   - Lifting empty hook . . .
3. Give span of crane between rails in feet.
4. State maximum height of lift required measured above and below top of rails, in feet.
5. State the radius of the jib at which the crane will be required to work, in feet. Maximum.. .. Minimum........ .
6. Is the maximum load to be lifted at this maximum radius ?
7. If not, state load in tons to be lifted at maximum radius.
8. Give maximum head room available, measured from top of gantry rails, in feet.
9. State maximum head room required between bottom of load and top of rails, in feet.

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1. If the crane is working on a regular cycle of operations, a torque-time curve should be sent with the inquiry. If not, state whether the maximum load is to be lifted frequently or only very occasionally. In the case of coal, ore, etc., loading or unloading, also state the quantity to be handled in tons per hour.

2. The speed of traversing is given in feet per minute, that for slewing may be either in feet per minute at a specified radius or as so many degrees of arc per minute, or as one revolution in so many minutes.

3. When the crane is to be run on existing rails, state permissible load per axle, in tons, radius of the sharpest curve the crane will travel over in feet, min., allowable clearances over bridges, etc.

4. + when whole lift is above rails, – when whole lift is below rails, +........ – ........when lift is both above and below rails.

5–7. Apply to all forms of movable jib cranes.

8. Applies to overhead travelling cranes with restricted head room for gear.

9. Applies to portal cranes, travelling bridges, etc., where the lifted load may have to clear trucks, or where trucks may have to pass under the crane.

10. For what class of work is the crane required ?
11. What type of crane is desired ?
12. How is crane to be operated ?
13. If by electricity, state system, voltage and frequency of the supply available.
14. Are brake magnets to be supplied ?
15. Is auxiliary gear to be supplied for dealing with light loads ?
16. Is the crane for indoor or outdoor use ?
17. Enclose dimensioned sketch, showing all clearances required.

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10. Is it to be used in a foundry, engine-room, gas works, dock, harbour, etc.
11. Overhead travelling, jib, portal, hammerhead, stripper, etc.
12. Hand, electrically, steam (state fuel to be used and calorific value in B.Th.U. per lb.) or hydraulically (state water pressure available in lb. per sq. in. abs.).
13. Electric gear will be offered. State maker's name if special pattern is desired.
14. If so, give answers to relative questions on brake magnet data sheet.
15. Only used with overhead cranes. State lifting capacity required.
16. In latter case is a shelter to be provided for driver and gear ?
17. The sketch should show the clearance required --
(*a*) Beneath jib.
(*b*) At back of crane when slewing motion is required (jib crane).
(*c*) Under crane body for trucks (portal cranes, travelling bridge cranes).
(*d*) Head room measured from crane rails (overhead cranes).
(*e*) Side room measured from crane rails (overhead cranes).
(*f*) Loading gauge (breakdown and other railway cranes).

## CRANE, FLOATING

1. State maximum load to be lifted in tons.
2. State maximum height to be lifted in feet, measured from water level.
3. Give the radius in feet at which the crane will be required to lift. Maximum . . . Minimum . ......... ... ..
4. State load in tons to be lifted at maximum radius.
5. State radius at which maximum load is to be lifted.
6. State speed of lift required in ft. per min.
7. Is crane to be of revolving or non-revolving pattern ?
8. Is crane to be self-propelling ? If so, state speed required in still water, in knots.
9. Is crane to be fitted with a hook or a grab ?
10. What type of drive is preferred ?
11. Are the dimensions of the pontoon limited in any way ? Give particulars.
12. For what class of work is the crane required ?
13. Submit dimensioned sketch of slip over which crane is to work.
14. Give particulars of any regulations governing the design.

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3–5. This may also be given as overhang measured from the edge of the pontoon, but clearly specify which is given in answer.

8. It is assumed that propelling machinery will be included in tender, in which case state whether steam or diesel drive is preferred.

10. State whether steam or electric. If electric, state system, voltage and frequency of available supply. Is the supply to be obtained from the shore, or must electricity be generated on board ? In latter case is generating plant to be included ?

11. By slip or dock against which it has to work, or by any dock gate, etc., through which it must pass.

It will be assumed that pontoon is also to be offered, in which case give some indication of the accommodation required on board.

## CRUSHER, ORE

1. State type of crusher required.
2. What output is required from the crusher in tons per hour ?
3. Give particulars of the material to be crushed.
4. State size of piece to be broken. Average . . . . Maximum. .... ....
5. State size of crushed material required.
6. Is crusher to be adjustable ?
7. How is crusher to be driven ?

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1. Jaw, up to ca. 30 tons per hour ; roller mill, 80 tons per hour ; hammer, 80 tons per hour. Conical up to 300 tons per hour. The output is limited by material and size of finished material required. Double or single discharge.
3. Name of material, limestone, granite, iron ore, phosphate, rock, etc. Hardness, state what material on the scale it will scratch. Wet or dry.
4. Give approximate dimensions in inches of average and largest piece.
5. State what size of mesh it is to pass.
6. So that various sizes of finished product may be obtained.
7. From transmission, give speed in r.p.m. and size of available pulley in inches, or electric motor. State speed in r.p.m.

It is assumed that neither motor nor other form of drive is to be included. If these are also to be offered, fill in respective data sheets.

# DESTRUCTOR, REFUSE

1. Give full particulars of the refuse to be handled.
2. State quantity to be dealt with in tons per 24 hours.
3. State average percentage moisture in the refuse.
4. Is waste heat utilization to be arranged ?
5. For what purpose will the steam so raised be utilized?
6. State steam pressure required in lb. per sq. in. abs.
7. State what type of boiler is preferred.
8. How will clinkers be dealt with ?
9. Give particulars of the soil on which the plant will be erected.
10. How is fan to be driven ?
11. State exactly what material tender is to cover.
12. Enclose fully-dimensioned plan showing proposed layout.

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1. Whether collected from house or factory, sewage sludge, etc. If these are mixed before feeding into destructor, state approximate proportion of each in the mixture.

2. It is here assumed that destructor will run continuously.

4. The waste heat from the gases should always be utilized where possible.

5. For driving machinery, heating water for baths, combination of both, etc. In all cases give fullest details. Is the steam supply required continuously over the 24 hours ?

7. The choice should be left to the manufacturer, unless there are existing boilers and it is desired to keep to the same type.

8. Sold as clinkers or is used for mortar or concrete making. Is it desired to make paving stones, tiles, or bricks ? If more than one of these methods is to be employed, state proportion of clinker to be used in each method.

10. It will only be necessary to answer this question in the case of very small destructors whose waste heat utilization is not employed. State quantity in lb. per hour and pressure in lb. per sq. in. abs. of any steam supply available, or system, voltage and frequency of electric supply.

11. In addition to the destructor itself with its normal accessories, state whether following plant is also be included in the tender
(*a*) Boiler, brick settings and flues.
(*b*) Chimney.
(*c*) Refuse charging gear.
(*d*) Clinker grinding plant.
(*e*) Mortar, concrete, paving stone, tile, or brick plant.
(*f*) Foundations.
(*g*) Buildings.
Where necessary enclose completed data sheets for this plant.

12. In addition to showing proposed layout, full particulars of any existing plant which may be utilized should also be given, such, for instance, as flues or chimney. Give full particulars of their existing use, stating amount of gases, etc., passing through them and their dimensions.

## DIMMER, THEATRE

1. Is the dimmer to be for a two- or three-wire system ?
2. What is the voltage of the system ?
3. State total lamp wattage to be controlled by dimmer.
4. Give number of lamps in each bank.
5. State type of lamp and size in watts.
6. How is the dimmer to be mounted ?
7. Give the order of the dimmer levers from left to right when facing the dimmer.
8. Are the levers to be interlocking ?
9. If non-interlocking levers are required, how many master levers are required ?
10. Enclose a sketch showing each group of dimmers to be controlled by a master lever.

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6. Are the levers to be on the top or bottom of the dimmer ? Is the dimmer to be mounted—

(*a*) On wall with no switchboard.

(*b*) On wall at back of a switchboard, and mechanically-operated from the front (in this case give the length of levers required).

(*c*) Directly on back of switchboard, but operated from the front.

(*d*) On front of switchboard.

(*e*) On ceiling or framework above head-level.

Are two or more banks to be operated one above the other from the same levers ?

# DREDGER

1. State finished depth to be left after dredging in feet.
2. What is the depth of water before dredging in feet ?
   Maximum........ Minimum............
3. Give maximum range of tides in feet.
4. If ground above water level is to be dredged, state to what height above minimum water level it is to be dredged in feet.
5. Give the direction and speed of current of the water to be dredged.
6. State the finished width of the channel to be made in feet.
7. What is the total amount of excavation to be done per day in cubic feet ?
8. Give particulars of the ground to be dredged.
9. Can soil be deposited alongside the channel to be made ?
10. Is the size of hull or draft of water restricted ? If so, give full particulars of the limits.
11. How is dredger to be driven ?
12. What type of dredger is required ?
13. Is the dredger to be self-propelling ?

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7. State number of hours to be worked.
8. Say whether mud, sand, gravel, rocks and boulders, etc.
10. By bridges, canals, docks, locks, etc.
11. If by a steam-engine, give full particulars of the water supply available, i.e. hourly quantity available in gallons per hour, whether clean or muddy, hard or soft. Also give particulars of the fuel available. If by an electric motor, give particulars of supply, i.e. system, voltage, and frequency.
12. Bow or stern buckets with discharge down side shoots, bucket barge loading, hopper dredgers or suction dredgers. The choice will, to some extent, be governed by the work to be done as detailed in answers to above questions.
13. If so, state speed of vessel required in knots. It will be assumed that it will be driven by fuel specified to question 11, unless other data are given to this question.

## DRILL, CORE

1. State type of drill desired.
2. What is the object of the bore ?
3. Is more than one hole to be drilled ? If so, give approximate number of feet to be drilled.
4. State maximum depth of hole to be drilled in feet.
5. Give diameter of final hole and core desired in inches.
6. Give particulars of the strata to be drilled if these are known.
7. What is the nature of the surface material ?
8. What is the depth of the surface material to rock in feet ?
9. Is the work to be done from the surface, or from underground ?
10. If from underground, give dimensioned sketch of the space available for the drill.
11. Also give particulars of the shaft down which the drill must be passed to the working place.
12. Give particulars of any supply of water available.
13. Can the water flow to the drill under gravity ?
14. If not, give distance from nearest point of water supply to drill and total lift in feet.

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1. Diamond or steel shot drill.

2. For water well, contract soundings (such as those for locks, dams, tunnels, bridges, etc.), prospecting (for iron, zinc, copper ores, coal, etc.).

6. If a geological survey of the district has been made, full use of it should be taken. If not, a survey of the local surrounding country by a geologist would materially assist, and such a report should be sent whenever possible.

7. Is the surface material, loam, sand, clay, gravel, boulders, volcanic lava, etc. ?

8. If the depth is great, chopping drills may become necessary.

11. State depth, in feet, from surface to place of working, size of entry to shaft, in feet, etc.

12. State nature of water, whether clean, muddy, hard, or soft, and approximate hourly quantity in gallons per hour available.

## 15. How is the drill to be driven ?

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15. The drill may be driven by hand, animal power, steam, oil, or gas engines, compressed air or electric motor. State which type is desired. If steam-engine is to be used, state class of fuel (i.e. coal, wood, etc.) and calorific value of fuel available. If steam supply is available, state steam pressure in lb. per sq. in. abs., and temperature in ° F. In the case of gas and oil engines, give particulars of the fuel to be used. In the case of the compressed air motor, state average pressure of air in lb. per sq. in. abs. available and, for the electric motor, state system, voltage, and frequency of the supply.

## DRILL, MINING

1. What is the length of the hole to be drilled in feet ? Average...... ..... Maximum. . .....
2. What is the diameter of the hole to be drilled in inches ?
3. Give particulars of the stone to be drilled.
4. What is the thickness of the strata to be worked in feet ?
5. State the daily output required in tons.
6. State number of working hours in which this output is to be obtained.
7. How frequently per day will shots be fired ?
8. How many holes will be fired at one time ?
9. State average depth of hole fired in feet.
10. In what time can the fallen material be cleared away, minutes ?
11. What is the size of the quarry in feet ? Length . ...... .. . Breadth.. . . Depth .
12. If the drill is to be used underground, give dimensions of place in which it will be worked.
13. Is the situation where the drill will be used dry or damp ?
14. Give particulars of any water available on the site.
15. What type of drill is to be supplied ?

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3. State whether material is hard packed, loose or shaly, give name of material to be worked, and full geological particulars of the strata should be given, particularly as to whether they are homogeneous or with faults or veins of other stones. In the latter case, state the nature of the veins.

5. If the quarry is at present worked by hand, give full detail of the present output, number of bore holes fired at one time, average depth of same, number of men per drill, and number of hours worked per day.

8. Also state what explosive will be used, dynamite, black powder, gelignite, etc.

12. When the drill is to be used in a restricted space, such as a tunnel, shaft, drift, trench, etc., a dimensioned sketch of the situation should be sent to enable working space available to be seen.

14. This should say whether clean, gritty, corrosive, etc., quantity in gal. per hour and pressure in lb. per sq. in. abs.

15. Steam, compressed air, or electric.

16. State system, voltage, and frequency of supply available.

17. Give particulars of steam or air supply.

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16. The particulars given will be assumed to be available at the spot where holes are being drilled, unless the following are also given: distance in feet from central station or nearest feeding point at which the voltage stated is available to bore hole. Is there a line running from the station or feeding point to a place near the drills, and being used at present for other purposes? In this case give present load on the line in kW. (or amp. per conductor), size of conductor, length of the line in feet, and whether overhead or underground.

17. Pressure in lb. per sq. in. abs. and temperature in ° F. available at drill. If point of supply is some distance from drill, state pressure and temperature at station, size of supply pipe, and distance in feet from station to drill.

## DRIVE, BELT

1. State continuous h.p. to be transmitted.
2. What is the distance between the centres of the driving and driven shafts in feet ?
3. State speed of shafts in revs. per min. Driver . . Driven . .
4. State maximum diameter of pulley in inches. Driver . . . Driven . . . .
5. State maximum face width of pulley in inches.
6. What is the diameter of the shaft in inches ? Driver . . Driven . . . .
7. Is a solid or a split pulley desired ? Driver . . . . Driven
8. Will the drive be horizontal, vertical, or inclined ?
9. If inclined, give the angle between the vertical and line of centres.
10. Are the driving and driven shafts parallel to one another ?
11. If not, give a dimensioned sketch showing exact layout of drive required.
12. If a cone drive is required, state the largest and smallest diameters of the cone in inches, and the rate of travel of the belt along the cone in inches per minute.
13. Is a fast and loose pulley used with the drive ?
14. If so, how many times per hour are the forks operated ?
15. Are arrangements available to take up any slackness in belt ? If so, give particulars.

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It is assumed that pulleys and belt will be offered together. If belt only is to be offered, answers to questions 4 and 5 should refer to existing pulleys. If an endless belt is required, state this fact.

6–7. Need only be answered when the pulleys are to be offered, as well as the belt.

10. When the shafts are parallel it should also be stated whether an open or crossed belt is to be used.

11. This includes all classes of special drives, angle drives, etc.

16. Give particulars of the machine to be driven by belt.
17. Is the load steady or fluctuating ?
18. Is the load impulsive or subject to shocks ?
19. Is the direction of rotation frequently reversed ? If so, state number of reversals per hour.
20. State atmospheric conditions in which belt will operate.
21. What type of belt is preferred ?
22. In the case of a steel belt, is electricity available for the magnetic pulleys ? Give particulars.

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16. This should state the type of driver machine, such as shafting, electric motor, etc., and the type of driven machine, such as lathe, miller, etc. If the power to the driven machine goes through a cycle of operations, particulars of the cycle should be given.

20. Is there much moisture, steam, chemical fumes, etc., present, or is oil or water likely to get on to belt ?

21. Leather, balata, fabric, camel hair, etc.

22. This should state system, voltage, and frequency of supply available.

# DRIVE, CHAIN

1. State maximum h.p. to be transmitted.
2. State distance between centres in feet.
3. Can this distance be adjusted? If so, by how much?
4. Give speed in revs. per min. of Driver............ Driven wheel ....
5. Give the maximum wheel diameter in feet permissible. Driver. . . Driven........
6. Give the maximum wheel width in inches permissible. Driver . . Driven. ...... ....
7. Is a solid or a split wheel desired?
8. Give particulars of machine to be driven.
9. Is the load to be transmitted steady or fluctuating?
10. Is the chain subject to shock?
11. Is a reversible drive required?
12. What type of driving machine is used?
13. Under what conditions is the chain to work?
14. Give a sketch of the drive.

See B.S.S., No. 228.

4. The speed of the driver given should be the average working speed. If there are considerable variations in the speed, give full details. The maximum and minimum speeds which will suit the machine to be driven should also be given, so that a suitable size of link may be chosen. If an exact speed ratio is required, this should be specifically stated on the inquiry.

7. If either of the wheels are to be fixed on an abnormal size shaft, the diameter of this shaft should be stated. Are there any restrictions as to the size of keyway?

8. This should convey some idea of the cycle of operations. Attention should be drawn to any details likely to limit the size of the chain, such, for example, as available width between two bearings. If there is any longitudinal float in the shaft, such as is met with in most electric motors, the amount should be stated.

9-10. If the load is fluctuating, state if there is much fly-wheel effect in the machine, as if not, it may be necessary to provide a spring wheel.

12. Steam or gas engine, water turbine, electric motor, etc.

13. State whether in a room where there is a lot of fluff, dampness, spray, dust or grit in the surrounding air. Must the chain be very silent?

14. This should show the relative position of driver and driven wheel. Mark the driver *R*, and show direction of rotation. Need not be to scale, but horizontal and vertical dimensions between the wheels should be given, as well as the distance betwen centres.

## DRIVE, GEAR

1. State h.p. to be transmitted by gear. Maximum ........Average........
2. What is the distance between centres of driving and driven shafts in feet ?
3. Can this distance be adjusted, and if so, by how much ?
4. State speed of the shafts in revs. per min. Driver ..........Driven
5. Give maximum wheel diameter permissible in feet. Driver ....... Driven.........
6. Give minimum wheel diameter permissible in feet. Driver............ Driven. ......
7. What is the diameter of shaft in inches ? Driver .......Driven .......
8. Is a solid or a split wheel desired ?
9. Give particulars of the machine to be driven through the gear.
10. Is the load steady or fluctuating ?
11. Is the load impulsive or subject to shocks ?
12. Is the direction of rotation frequently reversed ?
13. State if special class of pinion is desired.
14. Type of gear required.

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3. This should be expressed as | ... in.

4. This should be the average working speed. If the speed of the driver shaft can be varied by a small amount to allow a suitable pitch to be chosen, state extent of variation as $\pm$.......r.p.m. If the speed of the driver shaft must be exactly obtained this should be stated.

9. This should state the type of driver machine used, such as, electric motor, steam-engine, etc., and type of driven machine, such as, punch, spinning frame, loom, rolling mill, etc. If the power to the driven machine goes through a cycle of operations, particulars of the cycle should be given.

13. State whether rawhide, fabroil, C.I. bronze, etc., is preferred, and whether spur, worm, helical, double-helical gear, etc., is desired.

14. Spur, helical, worm, bevel, etc.

Instead of answering questions 1–6, the following information may be given if it is known—

(a) Pitch diameter.
(b) Material of which wheel is to be made.
(c) Pitch of teeth.
(d) Width of teeth (or width of wheel in helical gears, etc.).
(e) Diameter of bore.
(f) Size of keyway.

## DRIVE, ROPE

1. State continuous h.p. to be transmitted.
2. What is the distance between the centres of the driver and driven shafts in feet ?
3. State speed of shafts in revs. per min. Driver .......... Driven..........
4. State maximum diameter of pulley allowable in feet. Driver ........ Driven............
5. State maximum width of pulley allowable in feet.
6. State number of grooves in pulley, and give their size.
7. What is the diameter of the shaft in inches ? Driver Driven ..
8. Is a solid or split pulley desired ?
9. Will the drive be horizontal, vertical, or inclined ?
10. If inclined, give the angle between the vertical and the line of centres.
11. Are the driver and driven shafts parallel to one another ?
12. If not, enclose a dimensioned sketch showing exact layout of drive required.
13. Can the ropes be tightened ? Give details of any arrangements available.
14. Give full particulars of the machine to be driven.
15. State nature of load.
16. Is it necessary to reverse the direction of rotation ?

---

It is assumed that pulleys and rope will be offered together. If rope only is required, then answers to questions 4 and 6 should refer to existing pulleys.

6. The shape of the existing grooves is very important, and a plaster cast of the groove should, therefore, be sent with the inquiry.

11. State also whether an open or crossed drive is required.

14. State nature of driver machine (transmission, steam-engine, turbine, etc.), and type of driven machine (transmission, spinning frame, etc.).

15. State whether steady or fluctuating, impulsive, etc.

17. State atmospheric conditions under which the rope will work.
18. What system of rope drive is desired ?
19. State what class of rope is preferred.

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17. Damp, dusty, in chemical fumes, exposed to open weather, etc.
18. Endless rope or separate rope for each groove.
19. Cotton, manilla, hemp, etc.

## DRIVER, PILE

1. State weight of monkey required in cwt.
2. Give full particulars of pile to be driven.
3. Give height required for pile driver frame.
4. What type of drop is required ?
5. What type of frame is preferred ?
6. How is driver to be driven ?
7. In the case of steam driver, is the engine and boiler plant to be included ?
8. Give particulars of fuel supply.
9. Give particulars of the soil into which piles will be driven.

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1. Wood, concrete or steel, length in feet, section and weight, for average run. If there is a fair amount of work done on large piles, particulars of largest pile should also be given.

3. This will be fixed by length of pile to be driven, hence, length of longest pile should be given in addition to that under question 1.

4. Gravity or push.

5. Wooden or steel.

6. Hand, steam engine or electric motor. If steam supply is available, state steam pressure in lb. per sq. in. abs. and temperature in ° F. at engine stop valve. In case of electric motor, enclose data sheet.

8. Name coal, wood, etc., size, calorific value in B.Th.U. per lb. Is a supply of clean water available ?

9. Sand, shingle, gravel, clay, etc.

## DRYER, OIL

1. State the quantity of oil to be dried in gall. per hour.
2. Give full particulars of the oil to be dried.
3. State to what extent oil must be dried.
4. Is dryer to be used in conjunction with a filter ?
5. Is oil to be treated in any way to remove impurities ? Give particulars.
6. With what apparatus is the oil to be used ?
7. Is a drying oven to be included ?
8. Give particulars of electricity supply available.
9. Enclose a dimensioned sketch showing proposed layout.

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2. Name of oil, specific gravity, viscosity, both at 60° F., percentage of humidity, presence, and percentage of any sediment.
3. State permissible percentage of moisture which may be left in oil.
4. If so, enclose completed data sheet for oil filter.
5. State what impurities are to be removed ; acid, alkali, sulphur, salts, percentage of purity required for each. Whenever possible, send a sample of the oil to be purified.
6. Oil switches, transformers, lightning arresters.
8. For oil pump and drying oven. System, voltage, and frequency.

## DRYER, ROTARY

1. Give full particulars of the material to be dried.
2. State quantity of material to be dried per hour, in tons. Maximum. .. ... Average.. . . .. . ... .
3. State to what extent the material must be dried.
4. State temperature limit which must not be overstepped in ° F.
5. Is quick or slow drying required ?
6. Give particulars of the fuel to be used.
7. May the hot gases come into contact with the material ?
8. How is the material to be fed into the dryer ?
9. How is dryer to be driven ?
10. Enclosed dimensioned sketch showing proposed layout.

---

1. Name of material, size of material (state percentage left on passing through a specified sieve), percentage of moisture in raw material ; has material any corrosive action ? Does material become sticky or gummy on heating ?

3. Give percentage of moisture which may be left in the dried material.

4. The temperature may be limited, owing to changes which occur in the material.

6. Name, calorific value, in B.Th.U. per lb., and how fired in dryer. If exhaust gases may be used, state source from which obtained and temperature in ° F.

8. By plain shoot or automatic worm feed.

9. From transmission, state speed in r.p.m. or by electric motor ; state system, voltage, and frequency. Drive parallel or at right angles to dryer.

This data sheet may also be used for vertical dryer, coal drying oven, etc. In these cases state type of dryer required.

## DRYER, VACUUM

1. Give full particulars of the material to be dried.
2. State quantity of material to be dried in lb. per hour. Maximum. . . . . Average. . . . . . . .
3. State to what extent the material must be dried.
4. How is dryer pump to be driven ?
5. Give particulars of steam supply available.
6. Enclose dimensioned sketch showing proposed lay-out.

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1. Name of material, size, percentage of moisture in raw material; has material any corrosive action ?
2. For how long may the maximum demand last ?
3. State percentage of moisture which may be left in the material.
4. From transmission, state speed, or by electric motor, state system, voltage, and frequency available.

## DUMPER, WAGON

1. State amount of material to be dumped in tons per hour. Average. . . . Maximum..... . . ....
2. How long may maximum demand last in hours ?
3. Give particulars of the material to be dumped.
4. Give particulars of the wagons to be used.
5. Will more than one wagon be dumped at a time ?
6. State railway gauge of wagon.
7. State average weight of the contents of one wagon, in tons.
8. What type of dumper is required ?
9. How is dumper to be driven ?
10. For what purpose is dumper required ?
11. Enclose dimensioned sketch showing proposed layout.

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3. Name size, wet or dry.
4. Give railway designation in tons, class, and construction of wagon. The two latter points are of importance, as they will affect the choice of the type of dumper.
5. Two small but similar wagons of half the size of the large wagon may be simultaneously dumped in side or bottom dumpers.
8. End tip, side tip, or bottom dumps.
9. Hydraulically, state pressure available in lb. per sq. in. ; electrically, state system, voltage, and frequency.
10. Ship loading, dumping coal or ore on to a store heap, etc.

## ECONOMIZER

1. State quantity of feed water passing through the economizer in lb. per hour.
2. Give temperature of the feed water at the entrance to the economizer in ° F.
3. Give temperature of the flue gases at the entrance to the economizer in ° F.
4. State number, size and type of boilers used.
5. What is the total amount of water evaporated by these boilers from and at 212° F. in lb. per hour ?
6. What is the total amount of fuel burnt in lb. per hour ?
7. Give particulars of the fuel employed.
8. State boiler pressure in lb. per sq. in. abs.
9. Is artificial draught employed ? If so, give particulars.
10. Give particulars of any driving shaft available for driving the scraping gear.
11. If none is available, what type of drive is preferred ?
12. State what accessories are required.
13. Give dimensioned sketch of the boiler house.

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7. This answer should include its calorific value and a chemical analysis.

9. Give type of artificial draught employed, induced, forced, etc., and the draught in inches w.g. measured at the back of the boiler.

10. If a shaft is available, give its speed in r.p.m., diameter of pulley in inches, and indicate position of this pulley in relation to the flue in the sketch.

11. If by steam-engine, state steam temperature, ° F. If by electric motor, state system, frequency, and voltage available.

12. These may include pressure gauges, thermometers, pyrometers, etc.

13. This should show position of boilers, flues, and proposed position of the economizer.

## EJECTOR, AIR

1. What quantity of free air is to be exhausted in cu. ft. per min. ?
2. What vacuum is to be maintained in the chamber exhausted, inches of mercury ?
3. Give particulars of steam supply available.
4. For what purpose is the ejector required ?
5. State quantity of steam condensed in lb. per hour. Maximum. . ... Average.. ... . .
6. From what source does this exhaust steam come ?
7. State temperature of condensation in ° F.
8. Give head against which the condensate has to be delivered in feet.
9. How is the ejector to be driven ?
10. How is the exhaust steam from the ejector engine to be utilized ?

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1–2. When questions 1 and 2 cannot be satisfactorily answered, give fullest particulars of the size of chamber, size of pump, length and diameter of pipe line, etc.

3. State steam pressure in lb. per sq. in. abs., and temperature in ° F.

4. For exhausting creosoting chambers, etc., charging centrifugal pumps, long pipe lines, etc., condensing plant, etc.

5–10. Apply only to kinetic air ejectors for use with condensing plant.

6. From reciprocating engines or steam turbines.

9. Steam turbine or steam-engine (steam particulars will be taken from question 3), or electric motor, give system, voltage, and frequency of supply.

10. Will the exhaust steam from this engine or turbine be used to heat the eed water, or be discharged into a low-pressure stage of the main turbine ? In the latter case, state pressure of stage in lb. per sq. in. abs.

## ELEVATOR

1. State the quantity of material to be dealt with in lb. per hour. Average...... .Maximum . .....
2. Give a description of the material to be handled.
3. Is a vertical or inclined elevator required ?
4. If inclined, state the angle of inclination to the vertical.
5. State maximum total vertical distance in feet through which material must be lifted.
6. State total length of elevator in feet.
7. What type of elevator is desired ?
8. How will the material be fed to the elevator ?
9. Is the feed constant or intermittent ?
10. If the latter, give the maximum quantity of material to be dealt with in pounds, and the time in which the material must be cleared in minutes.
11. How is the elevator to be driven ?
12. Give a dimensioned sketch showing proposed lay-out.

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1. State also how long the elevator will be required to deal with the maximum demand.

2. This should state the name of the material, coal, ash, iron ore, grain, etc., whether wet or dry (state percentage of moisture), weight in lb. per cub. ft., and weight of largest piece likely to be handled in lb.

3. If the inclination to the vertical is not the same throughout the length of the elevator, the length of the elevator for each inclination must be given, and the dimensioned sketch should show how these stand in relation to one another.

6. Measured at elevator surface.

7. Belt, chain, or bucket elevator ; open or enclosed. If enclosed, state whether enclosing is to be in steel, wooden, or lattice framing ; whether fixed or portable (in latter case for loading wagons from coal piles, etc.).

11. Usually this will be from some existing line shafting. In which case the speed, diameter of pulley, direction of rotation, and position relative to the elevator of the proposed drive, should be given. If electric drive is contemplated, the system, voltage, and frequency of the supply available should be stated.

## ENGINE, GAS OR OIL

1. State what type of engine is required.
2. Give maximum b.h.p. which the engine is to develop continuously.
3. State what overload the engine is required to carry.
4. For how long is this overload to be carried ?
5. State normal full-load speed required in r.p.m.
6. Give full particulars of the fuel to be used.
7. What is the engine to drive ?
8. State nature of drive.
9. Give the fly-wheel effect of the rotating parts of the machines to be driven in ft.$^2$ tons.
10. State the maximum degree of cyclic irregularity permissible.
11. State altitude of site in feet above sea-level.
12. Is a source of compressed air available ? Give particulars.

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Oil tanks, water tanks, and cooling towers will not be included unless specified.

See B.S.S., Nos. 120, 211, 212, 213.

1. Horizontal or vertical, open or enclosed, single- or double-acting, two- or four-cycle. In case of oil engines, state whether Diesel, hot bulb, etc.

2. The efficiency of the type of engine varies very considerably with the load, particularly in the case of gas engines. To obtain an economical drive and still be able to deal with small variations in load, it is extremely important to calculate the b.h.p. required with care.

3. Express as a percentage of the b.h.p. given under (2). Gas engines are very unsuitable for handling overloads, they cannot deal with more than 5–10 per cent, depending on design of plant.

6. Give name, blast furnace, coke ovens, producer gas, etc. Petrol, alcohol, crude, refined, or residual petroleum, tar oils, calorific value in B.Th.U. per cub. ft. or lb. Temperature in $^\circ$F. at engine stop valve. Pressure at engine stop valve in lb. per sq. in. abs. (Does this pressure vary ? If so, say per ± . sq. in. abs.) State dust content for blast furnace gas in grains per cub. ft. If there is any possibility of the chemical composition of the gas varying, this should be stated.

7. Continuous or alternating current generators, transmission shafting, fans, etc. In the case of small engines direct-coupled to a generator, fan, etc., is a combined bedplate to take the generator to be included ? If so, enclose dimensioned sketch of generator.

8. Direct-coupled, belt, rope, etc.

9–10. Need only be given in case of an engine required for driving electric generators which have to work in parallel.

12. Compressed air is used for starting large gas engines, pressure required

13. Is a supply of clean water available ? Give particulars.
14. How are air and gas compressors to be driven ?
15. Will the exhaust gases be used under a boiler ?
16. State system, voltage, and frequency of electricity supply available.
17. Enclose dimensioned sketch showing proposed layout.

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is 20–25 At. Is a compressed air container to be supplied ? It is also used for blowing out exhaust gases from cylinder, pressure ca. 0·5 At. And, finally, is used for air supply for mixture, pressure ca. 200 cm., w.g. If a supply is available, state pressure in lb. per sq. in. abs., and quantity in cub. ft. free air per minute.

13. This is required for cooling the cylinder, squirting into the cylinder during compression, and for cooling the air before mixing. It must, therefore, be clean. State quality, quantity available in gal. per minute, pressure in lb. per sq. in. abs., and temperature at engine inlet in ° F. Also state whether it can run to waste or must be recooled.

14. These are usually driven direct by the engine, but may be separately driven by a steam turbine if the exhaust gases are used for steam raising.

15. This usually only comes into question in the case of large gas engines.

16. May be used for driving compressors, but is necessary for firing large gas engines.

## ENGINE, LOCOMOTIVE TYPE

1. State maximum b.h.p. which the engine is to develop continuously.
2. State percentage overload required and its duration.
3. State speed desired in revs. per. min.
4. What type of engine is desired ?
5. Is the engine to be condensing or non-condensing ?
6. Give particulars of cooling water available.
7. Give particulars of the fuel to be used.
8. What is the engine to drive ?
9. State what type of drive is preferred.
10. If steam is to be taken from the boiler for other purposes than the engine, give full particulars.
11. Is a boiler to be arranged for iron chimney, or to connect into underground flue ?
12. Is a portable or semi-portable engine required ?
13. State what accessories are to be included.
14. Are there any special regulations governing the design of the engine ?
15. Enclose dimensioned sketch of layout proposed.

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See B.S.S., No. 42.

Unless conditions given above necessitate otherwise, it will be assumed that a superheated steam plant is to be offered. Extent of superheat will be decided by maker unless specified in inquiry.

4. Simple or compound, with or without forced lubrication to bearings.

6. State source, quantity available in gal. per hour, average temperature in ° F., and head in feet. If it is necessary to recool the water, is a cooler to be included ? If no head is available, is a circulating pump to be offered ? If so, in both cases, enclose completed data sheet. Are the necessary pipes for cooling water system to be included ?

7. Name, coal, coke, wood, etc., size, calorific value in B.Th.U. per lb.

8. Transmission line driving machine, shop, factory, etc., electric generator, etc.

9. Direct-coupled, belt, rope, or chain drive.

10. State for what purpose it will be used, quantity in lb. per hour, pressure required in lb. per sq. in. abs., whether superheated or saturated steam is required and, in former case, steam temperature in ° F.

13. These may include chequer plates for pipe trenches, iron chimney (state height required to go through roof), escape pipe for steam from safety valves, steam pressure gauge, tachometer, etc.

15. The sketch should show position of engine and proposed drive, position of fresh water supply, position of cooling water supply (height of this source measured from engine-room floor level should be given, as well as distance from engine, in order to enable the head to be calculated).

## ENGINE, STEAM

1. State maximum b.h.p. which engine is to develop continuously.
2. State what overload is required as a percentage.
3. For how long is this overload to be carried ?
4. What is the steam pressure in lb. per sq. in. abs. and steam temperature in ° F. at the engine stop valve ?
5. State speed desired in revs. per min.
6. Is the engine to exhaust into a condenser, into the atmosphere, or against a back pressure ?
7. State vacuum in inches of mercury or back pressure in lb. per sq. in. abs.
8. At what load are the most economical results required ?
9. What type of engine is required ?
10. What is the engine to drive
11. State nature of the drive.
12. Give the fly-wheel effect required in the engine fly-wheel in $ft.^2$ tons.
13. State the maximum degree of cyclic irregularity permissible.

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See B.S.S., No. 42.

5. If speed variation is required, state range and give outputs required from the engine at these speeds in b.h.p.

6. In some instances, part may be exhausted into a condenser and part supplied against a back pressure. In this case give full particulars of the demand against back pressure; if possible, supply a load chart (for a day) showing heating steam demand plotted against time, for the maximum and minimum demands likely to occur during the year.

8. Express as b.h.p. or as a percentage of maximum continuous load. (Question 1.)

9. Open or enclosed, uniflow, vertical, or horizontal, single, compound, or triple expansion.

10. Also state whether the engine bedplate is to be extended to carry the machine to be driven, in which case enclose dimensioned drawing of machine to be driven to enable bedplate to be calculated.

11. If direct-coupled, state whether a solid or flexible coupling is to be used. If belt or rope drive, give particulars of pulleys required.

12–13. Need only be answered in the case of an engine required to drive an electric generator working in parallel with others.

14. What accessories are required ?
15. Are pumps to be driven by the engine ?
16. Are turning engines required ?
17. Is condenser to be fixed to back column ?
18. State any special requirements.

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15–18. Apply only to marine engines. As in this instance, the design is nearly always special, fully dimensioned drawings of the engine should be supplied, or a dimensioned drawing of that portion of the ship into which the engine will be fitted, sent to enable available space to be seen.

16. State whether reversing, direct, or all round.

17. Or to side of ship ?

18. Such as cylinders with liners, special gland packing. Also state to which survey, Board of Trade, etc., the engine must comply.

## ENGINE, WINDING, ELECTRICALLY DRIVEN

1. Is the shaft vertical or inclined ?
2. Give particulars of the material to be hoisted.
3. What is the normal net load per trip in tons ?
4. What is the maximum load to be hoisted per trip in tons ?
5. State number of consecutive trips on which the maximum load will be carried.
6. What is the maximum number of men to be carried in the cage per trip ?
7. Give net hourly load (excluding number of men, rock, etc.) to be hoisted in tons.
8. Is this quantity to be hoisted from several levels ? If so, give net load per hour from each level, number of trips per hour, from each level, and depth in yards of each level.

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This data sheet may also be used for steam-drive winders, if particulars of steam to be used, water and fuel available, are given in place of electrical data.

If the electrical winder is intended to replace steam winder, the following particulars of the existing plant should be given—

(*a*) Type of engine employed.

(*b*) Steam pressure in lb. per sq. in. abs., and temperature in ° F. employed.

(*c*) Condensing or non-condensing and vacuum obtained.

(*d*) Number and diameter of cylinders and cut-off employed.

(*e*) Stroke.

(*f*) Speed.

(*g*) How engine is connected to drums. Direct-coupled or single- or double-gearing, type of gearing, particulars of gearing.

(*h*) Particulars of drum used. Number, diameter (if conical, state maximum and minimum diameters; if bobbins, state initial and final radius: if cylindrical-conical, state number of turns on each part), width, weight, whether fast or loose.

(*i*) Particulars of head sheaves. Diameter, weight, and height of centre above ground level in feet.

(*k*) Particulars of rope. See question 20, in main sheet.

(*l*) Winding particulars. Present time in seconds for one complete wind, maximum and minimum time in seconds allowed for stops.

(*m*) Names of engine and winder maker.

(*n*) Sketch of existing plant, showing distances from drum to sheaves, etc.

1. Coal, iron ore, zinc ore, rock, etc.

4. If a considerable number of trips with this load follow one and another consecutively, it may be necessary to consider such maximum load as the normal load, as the heating caused thereby may necessitate a larger motor.

9. Is the hoisting from different levels an exceptional requirement, or is it a part of the regular normal programme ?
10. Will it be necessary at any time to lower special loads ? Give particulars of the load and its maximum weight in tons.
11. State total number of trips per shift and number of consecutive trips per shift, in which men will be carried.
12. State total number of trips per shift and number of consecutive trips per shift, in which rock will be carried.
13. What is the length of a shift in hours ?
14. How many shifts are run per 24 hours ? Is hoisting carried on in all of them ?
15. What is the maximum depth of the mine in yards ?
16. Is this already reached ? If not, give approximate date when winding will be required from this depth.
17. What maximum rope speed in feet per minute is specified when—
    (*a*) carrying men.
    (*b*) carrying load.
    (*c*) for shaft inspection.
    (*d*) for other purposes.
18. Is a single or a double drum hoist to be used ? If the former, can a counterbalance weight be provided ?
19. Are the acceleration and retardation periods specified ? If so, give values in seconds.

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10. Such as lowering pumps, hoists, etc., for work in the mine.

17. This is the maximum rope speed required when travelling at constant speed. If this cannot be given, it will be chosen so as to fit in with the other data given.

18. In the case of small winders, are fast and loose drums to be used, and if so, what type of clutch is preferred ?

20. Is a particular class of rope specified? If so, give full particulars.
21. Is the rope counterbalanced? If so, state how it is balanced.
22. What is the minimum time in seconds required to load and unload the cage?
23. How many decks has the cage?
24. Must the cage be raised each time to unload from the different decks?
25. What is the weight of the empty cage, including the safety apparatus, and connections between the rope and the cage, in tons?
26. How many wagons go on each deck?
27. What is the weight of an empty wagon, in tons?
28. What is the weight of a skip, in tons?
29. Will it be necessary to raise the cage above the discharging level?
30. Are the dimensions of the drum, reel or rope pulley limited in any way? If so, give particulars.
31. What type of brake is specified?

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20. The particulars given should include—For round ropes: (*a*) Outside diameter in inches. (*b*) Number of strands. (*c*) Number of wires per strand. (*d*) Size of the individual wires in S.W.G. For flat ropes: (*e*) Width and thickness in inches. (*f*) Number of cores. (*g*) Number of strands per core. (*h*) Number of wires per strand. (*i*) Size of the individual wires in S.W.G.

For both types of rope: (*k*) Material of which it is composed. (*l*) Breaking strength in lb. per sq. in. for an individual wire. (*m*) Breaking strength in tons per sq. in. for whole rope. (*n*) Weight in lb. per yard run of rope.

21. Is it counterbalanced by means of a counterweight, tail rope, conical drum, or a reel?

22 and 42. The minimum turns should be given separately for loading and unloading.

24. Or are all decks unloaded simultaneously? If the cage must be raised each time to unload from the different decks, the time required for this should be included in question 22. Are rests employed? If so, is it necessary to raise the top cage when the bottom cage is on the rests, and is it also first necessary to raise the cage off rests before lowering?

30. The maximum permissible diameter of the drum should be stated, and whether the rope may be wound on in two layers.

31. Block, band, differential brake, etc.

32. How many mechanical brakes are to be supplied, and how many operating devices are to work on one and the same brake ?
33. Are there any regulations in force with regard to mechanical brakes or safety devices ? If so, give particulars.
34. Give the diameter in feet of the rope guide pulleys, and state their fly-wheel effect in $ft.^2$ lb.
35. Is the shaft an outcrop, or does it feed a vertical shaft ?
36. What is to be the total length of the shaft, in yards ?
37. What is the angle of inclination to the horizontal ?
38. Is this hoist to be erected underground ? If so, give a dimensioned sketch showing exact position with regard to the main shaft and the dimensions of the chamber in which it will be erected.
39. What are the minimum net dimensions in feet of the shaft and tunnel through which the hoist has to be passed ?
40. What are the maximum permissible weight and dimensions which can be allowed for any part of the hoist ?
41. Will the skips be charged and discharged automatically ?
42. If so, what is the time in seconds allowed for charging and discharging respectively ?
43. Is the motor to be direct coupled to the hoist, or to drive through gear ?

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32. How is brake to be actuated—by weight, compressed air, magnetic arrangement, etc.

35–43. Apply to inclined hoists.

37. For varying gradients, a profile map should be sent showing amount, length, and position of each gradient.

44. Is a central station supply available? If so, give particulars.

45. If not, is a power house to be designed?

46. What is the distance in yards between the power house switchboard and the winding engine motor?

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44. If a supply is available, state: (*a*) System. (*b*) Voltage. (*c*) Frequency. (*d*) Number of generating units. (*e*) Size of each unit in kW. or kVA. (*f*) Overload capacity of each unit. (*g*) Send average daily load curve in kW., showing present load on the station. (*h*) State whether the prime movers are steam-engines, steam turbines, gas engines, or water turbines.

45. Give particulars asked for in separate data sheet.

## EQUIPMENT, GAS BURNING

1. With what apparatus is it to be used ?
2. Give particulars of the fuel to be used.
3. Give dimensioned sketch of the furnace in which the gas is to be burned.
4. What is the evaporative capacity of the boiler ?
5. What quantity of material is to be handled in lb. per hour.
6. To what temperature is this material to be raised in ° F. ?
7. Give particulars of the material to be handled.
8. State pressure at which gas will be delivered to burner in inches w.g.
9. Is a supply of compressed air available ? Give particulars.
10. Enclose a dimensioned sketch showing proposed layout.

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1. Boiler, annealing furnace, muffle furnace, kilns, ladles, evaporating pans, etc.

2. Name (Mond, water, blast furnace, gas, etc.), calorific value in B.Th.U. per cub. ft., and temperature at burner in ° F.

3. Show all obstructions.

4. In lb. per hour from and at 212° F. In case of evaporating pans, state the number of gallons of juice to be evaporated per hour.

5–7. Apply to annealing and similar furnaces, ladles, etc.

7. Quantity of steel, etc.

9. Pressure in lb. per sq. in. or inches w.g., and quantity of free air available in cub. ft. per minute.

10. This should indicate proposed position (or existing arrangement if a change over is in question) for boiler, gas producer, economizer, flues, and chimney with all dimensions.

## EQUIPMENT, OIL BURNING

1. With what class of plant is it to be used ?
2. Give particulars of the oil fuel to be used.
3. Give dimensioned drawing of the furnace.
4. What is the evaporative capacity of the boiler ? Normal ..... .. Maximum .
5. What quantity of material is to be heated per hour, in tons ?
6. To what temperature is this material to be brought in ° F.
7. Give particulars of the material to be heated.
8. What is the pressure of steam supply in lb. per sq. in. abs. ?
9. Is any supply of compressed air available ? Give particulars.
10. How many of the above plant will be working together ? Give maximum combined capacity.
11. Is exhaust steam available for heating the oil ? Give particulars.
12. Give static head in feet against which oil must be pumped from tank to burner.
13. Enclose dimensioned sketch showing proposed layout of the plant.

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1. Boiler, heat treatment furnace, melting furnace, etc.
2. Class, calorific value in B.Th.U. per lb.
3. This particularly refers to furnace door or front, and space (furnace) in which the oil will be burnt. Show all obstructions, such as bridge walls, etc., in furnace.
4. In lb. per hour from and at 212° F.
5. Or weight of charge to be melted in tons.
7. State quality of steel to be treated, etc.
9. Pressure in lb. per sq. in. abs., or inches w.g., and quantity in cub. ft. of free air per minute.
11. From what source, pressure in lb. per sq. in. abs., and quantity in lb. per hour.
12. Exclusive of pipe friction and pressure required for burners.
13. This should indicate proposed positions (or existing arrangement if a change over is in question) for oil tank heater, etc., size of each boiler or other plant to be fired, size of flues, diameter and length of chimney, etc.

# EVAPORATOR

1. Give full particulars of the liquid to be concentrated.
2. State quantity of liquid to be dealt with per hour, in gallons.
3. Must the liquid be agitated ?
4. How is evaporator to be heated ?
5. State maximum temperature allowable for liquid during concentration, in ° F.
6. Will the vessel be subjected to internal or external pressure ? Give particulars.
7. State particulars of steam supply available.
8. Give particulars of water supply available.
9. What type of evaporator is desired ?
10. Give particulars of any power available for driving evaporator.
11. Enclose dimensioned sketch showing proposed layout.

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See B.S.S., No. 186.

This data sheet may also be used for vats, chemical containers, vacuum pans, heaters, stills, or multiple effect evaporators.

1. Should include name of liquid, its concentration as supplied to evaporator and desired concentration, its temperature in ° F. as supplied, its viscosity as supplied and, at the temperature used for concentration (this will be a little less than that given in answer to question 5), its chemical composition. Has it any corrosive action on metals ?

2. This refers to raw liquid. It is also useful to state daily output of concentrate required and number of working hours per day.

4. By flame, by bath (oil or water), by steam.

6. State internal pressure in lb. per sq. in. abs.

7. Source, quantity in lb. per hour, pressure in lb. per sq. in. abs., and temperature in ° F.

8. Source, quantity in gallons per hour and temperature in ° F., pressure in inches w.g.

9. Single, double, triple, quadruple, or quintuple evaporator ; vacuum pan, coil or calandria type, still or heater.

10. Usually this will be from some line shafting, in which case the speed, diameter of pulley, direction of rotation, and position relative to the evaporator, should be given. If electric drive is contemplated, the system, voltage, and frequency of the supply available should be stated.

## EXCAVATOR

1. What type of excavator is required ?
2. What capacity of bucket is required, in cubic yards ?
3. Give total quantity of material to be removed per day.
4. Give particulars of the nature of the soil to be handled.
5. What class of drive is preferred ?
6. Give particulars of the fuel available.
7. Is a source of pure water for the boiler available ?
8. Give system, voltage, and frequency of electricity supply.
9. If excavator is to be self-propelling, what class of wheel is desired ?
10. Into what type of wagon is the material to be unloaded ?
11. Is a water supply under high pressure available ? Give particulars.
12. If not, is an independent source of fairly clean water available ?

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Questions 1, 3, 4, 6, 7, and 8 apply to all types of excavators.
Questions 2. 5, 9, and 10 apply to bucket type of excavators.
Questions 11, 12, 13, and 14 apply to jet type of excavators.

1. Jet, shovel, drag-line, grab, or clam-shell, trench, etc.
3. Express as. . ..... .cub. yd. in.... ..... working hours.
4. Clay gravel, sand, shale, etc. In the case of the softer soils are there any boulders (give approximate size of biggest) or much rock to be met.
5. Steam or electric.
6. Name, coal, wood, etc., size ; calorific value in B.Th.U. per lb.
7. State source of water and its hardness.
9. Caterpillar tractors, tractor wheels, road wheels, railway wheels (state gauge).
10. Carts, tip wagons (on light railway), full gauge railway wagons.
11. State pressure in lb. per sq. in. abs., and quantity available in gallons per hour.
12. State whether river, canal, lake, sea, etc., and approximate flow in cub. ft. per minute; in case of canals, rivers, etc., condition, clean, muddy, etc.

13. How is the pump to be driven ?
14. Enclose a dimensioned sketch of the land to be evacuated.

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13. Steam or electric. Answers to 6, 7, and 8 will be required.
14. This should show contour lines at 5-ft. intervals, give position of river, etc., show what land is to be evacuated, and indicate point where mud is to be delivered.

# EXHAUST GAS UTILIZATION

1. State total quantity of exhaust gas available in lb. per hour.
2. Give full particulars of each source from which this gas is obtained.
3. State the temperature of the exhaust gas in ° F.
4. For what purpose will the hot gases be used ?
5. Give particulars of the quantity of heating required.
6. Enclose dimensioned sketch showing proposed layout.

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Exhaust gas may be used to heat air for boiler furnaces, etc., directly in boilers to produce steam ; in boilers to produce hot water for baths, etc., in distilling apparatus, etc.

2. Following information should be given—

(*a*) From what source is gas obtained ; furnace, gas engine, etc.

(*b*) Nature of work which the source performs ; Siemens Martin furnace, cement furnace, annealing furnace, boiler plant, gas or Diesel engine, etc.

(*c*) Size of furnace, i.e. lb. of material handled per hour. Or send data sheets for reheating, melting or heat treatment, furnace, boiler, etc.

(*d*) Quantity of gas being burnt per hour in lb.—for each furnace, etc.

(*e*) Maximum h.p. developed by the engine.

(*f*) Average h.p. developed by the engine.

(*g*) Particulars of fuel used, i.e. B.Th.U. per lb. or cub. ft., name.

(*h*) Type of engine.

(*i*) Number of cylinders.

(*k*) Speed in r.p.m.

(*l*) Whether two- or four-cycle.

3. At engine exhaust.

4. (*a*) Heating air, (*b*) Heating water, (*c*) Boiling water (high pressure), (*d*) Distilling water.

5. Following particulars should be given—

Air heating : (*a*) For what purpose will hot air be used ? Room heating, boilers, etc.

(*b*) State cub. ft. of air to be heated per hour.

(*c*) State temperature of hot air required in ° F.

(*d*) Number of rooms.

(*e*) Size of each.

(*f*) Particulars of windows, doors, walls, etc.

(*g*) Particulars of work carried on in each room.

Heating or boiling water: (*a*) For what purpose will the hot water be used? Heating, boiler feed, baths.

(*b*) Quantity of water to be heated in gallons per hour. Average .. .. .. .. Maximum.. .. ..

(*c*) Temperature of water to be heated in ° F.

(*d*) Temperature to which water is to be raised in ° F., or boiler pressure. (See also data sheet for feed water heater, liquid evaporator, etc.)

Distilling apparatus: (*a*), (*b*) As for water heating.

(*c*) What system of distilling apparatus is preferred ? (See also data sheet for distilling apparatus.)

6. This should show position of each engine, furnace, etc., size of each exhaust flange or pipe, flues, chimney, etc., proposed position for boiler, heater, etc.

# EXHAUST STEAM UTILIZATION

1. State the total quantity of exhaust steam available in lb. per hour.
2. Give full particulars of each source from which the steam is obtained.
3. What is the steam pressure at engine exhaust valve at present in lb. per sq. in. abs. ?
4. For what purpose will the exhaust steam be used ?
5. Is a source of live steam available ? If so, give particulars.
6. When steam is not to be used in turbines, is it to exhaust to atmosphere or to be condensed ?

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In conjunction with this data sheet the following should be consulted, and may also be used when they are applicable: Steam accumulator, steam turbine, mixed pressure or exhaust steam types, heating installation, water heater, liquid evaporator.

2. The information given in answer to this question will enable distribution of the quantity given to question 1 to be seen. The following information, when applicable, should be given—

(*a*) Nature of the work on which the engine, etc., is employed (rolling mill, press, etc.).

(*b*) Number and diameter of each cylinder in inches.

(*c*) Stroke in feet.

(*d*) Speed in r.p.m.

(*e*) Point of stroke at which steam is cut off in h.p. cylinder.

(*f*) Initial steam pressure in lb. per sq. in. abs., and steam temperature in ° F., at engine stop valve.

(*g*) Duration of working cycle in seconds.

(*h*) Duration of pause in seconds.

(*i*) Quantity of steam used per cycle in lb.

(*k*) If engine runs without steam under the action of the load, state percentage of the working period during which the steam is taken.

(*l*) State average quantity of steam used in lb. per hour.

(*m*) State maximum rate at which steam is used during cycle in lb. per second.

(*n*) When possible, send continuous indicator diagram of the engine or other source.

(*o*) When more than one source of exhaust steam is to be used, a time diagram, showing how supply of exhaust steam from each source stands relative to the other sources should be sent.

3. When possible, also state the highest exhaust pressure which can be used at the engine exhaust, and still allow the mechanical load on the engine to be supplied.

4. Room heating, cooking, drying, steam turbines, etc.

5. Quantity in lb. per hour, pressure in lb. per sq. in. abs. Temperature in ° F. Mark position of this source on dimensioned sketch.

7. Give particulars of cooling water available.
8. Is heating to be done by a form of air condenser ?
9. Give particulars of the amount of heating required.
10. Enclose dimensioned sketch showing present layout of plant supplying the exhaust steam, and proposed position of the plant to utilize this steam.

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7. Quantity in gallons per hour, temperature in ° F.

8. This is a form of condenser which is built into the exhaust main of the engine, and through which the air to be warmed is led. The hot air is then led to point of use, and the steam to condenser.

9. For room warming, give—

(*a*) Cub. ft. of warm air per hour required.

(*b*) Temperature of this air in ° F.

(*c*) Or number of rooms, size of each, particulars of doors, windows, walls, etc., and work carried on in the room. (See also heating and ventilating installation.)

For cooking and drying apparatus, give—

(*a*) Number of cookers, etc.

(*b*) Size of each cooker.

(*c*) Material to be cooked or dried.

(*d*) Weight of material to be cooked or dried in lb. per hour (or number of gallons).

(*e*) Percentage of moisture before and after drying.

(*f*) Temperature to be maintained in cooker, etc., in ° F.

(*g*) Length of time this temperature is to be maintained in hours. (See also data sheet for water heater, liquid evaporator.)

10. This should show position of each source of exhaust steam (rolling mill or winding engines, presses, pump engines, etc.); size of its exhaust flange, proposed position of turbine condenser, accumulator, heating mains, cookers, dryers, etc., position of live steam supply, etc.

## EXTRACTOR, LIQUID, ELECTRICALLY DRIVEN

1. State the inner and outer diameter of the wash drum in inches.
2. State the height of the wash drum in inches.
3. Give the fly-wheel effect of the rotating parts in ft.$^2$ lb. With load .... Without load ..
4. What is the h.p. required to drive the drum at normal full-load speed ?
5. State normal full-load speed of drum, in r.p.m.
6. What material is to be washed or dried ?
7. State weight of load in pounds.
8. Give weight of the rotating parts without load, in lb.
9. State number of fills per hour.
10. In how many minutes after starting is the drum to reach its full-load speed ?
11. How many minutes will the fully loaded drum run at full speed ?
12. How many minutes will the drum stand still ?
13. Will the drum be filled whilst running ?
14. If so, how many minutes after starting the drum does the filling commence ?
15. What is the condition of the room in which the motor will be erected ?
16. Is the bottom bearing of the drum an ordinary step bearing or an oil pressure bearing ?
17. If the latter, how much will the shaft be lifted when the oil pressure comes on, in inches ?
18. State system, voltage and frequency of the available supply.

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5. It is assumed that the motor can be direct-coupled to the drum ; if a belt drive is preferred this should be stated.

6. Sugar, washing, metal turnings, etc.

9. That is, how many times is it required to start the motor per hour ?

15. This should state whether the room is dry or steamy wet, and average and maximum temperature in ° F. near the motor.

# FACTORY, COMPLETE

1. What is the factory required to make ?
2. Give a complete specification of the finished product required.
3. State the quantity to be produced.
4. State number of working hours per day and per week, and number of working days per annum.
5. Give a complete specification of the raw materials to be employed.
6. State how raw material will be delivered to the factory.

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See B.S.S., Nos. 15, 78.

1. Paper, paper pulp, beer, whisky, cement, flour, casks, barrels, oil, feeding cake, rubber tyres, etc.

2. State—

(*a*) Use to which it will be put, example, cask to carry oil, nails, etc.

(*b*) Dimensions and weight of each size to be made. It is advisable to enclose dimensioned sketch of each article to be produced ; or fineness to which finished article is to be ground. In this case, state what percentage may be left on a specified sieve. Or concentration or strength to which a liquid is to be brought.

(*c*) Number or quantity of each size or grade to be turned out in the time specified under (3). This could also be expressed in the form of percentages of the total output.

(*d*) Surface finish required.

(*e*) Any tests which it will have to pass.

(*f*) Any other points peculiar to the product.

(*g*) Whenever possible, submit samples.

3. State as number, lb., tons, gallons, cubic feet, etc., whichever is most appropriate, of each size to be made. State also maximum and average amount to be produced in one or other of the following units of time, per hour, day, week, year, whichever is most important.

4. If day and night operation is necessary for all or any part of the machinery, specify which parts. If the trade is seasonal, give full particulars of the demand.

5. State for each material to be employed—

(*a*) Name.

(*b*) Dimensions and weight, or fineness if ground, for each size employed.

(*c*) Its physical properties, i.e. tensile, bending, crushing, shearing or torsional strength, hardness.

(*d*) Chemical analysis.

(*e*) Finish.

(*f*) Whether wet or dry and percentage of moisture.

(*g*) If two or more raw materials are to be mixed together, state proportions of each which are to be used.

(*h*) Submit samples of all raw materials to be used.

6. By road, rail, or water. State if suitable discharging plant is also to be included.

7. Give full particulars of any special processes to be employed.
8. State any preferences with regard to the types of machinery to be employed.
9. How is the machinery to be driven ?
10. Is the prime mover, with all necessary transmission to the machinery, to be included ?
11. Give particulars of any restrictions as to the size of machinery which may be employed.
12. Give full specification of the fuel to be used
13. Give particulars of any electricity, steam, water, gas, or compressed air supply available.
14. Is the machinery to be placed in any existing buildings ?
15. Is a new building to be included in the tender ?
16. Give particulars of any regulations relating to buildings, machinery, etc.

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7. Ex. Wet or dry in cement works, filter or chemical extraction of oil, sand-lime or ordinary clay in brickworks, air or steam drying, etc.

8. Details or specification of each type of machine to be employed should be given, if these are not left to the maker. The choice of the size of the machine to be used should be left to manufacturer.

9. From transmission or by electric motor (group or individual).

11. Caused by transport, etc.

12. Name, size, chemical analysis, calorific value in B.Th.U. per lb., or cub. ft.

13. Electricity. State system, voltage, and frequency—

*Steam*. Source, quantity in lb. per hour, pressure in lb. per sq. in. abs., and temperature in ° F.

*Gas*. Name, quantity in lb. per hour, pressure in inches w.g.

*Air*. Quantity in lb. per hour, pressure in lb. per sq. in. g.

Where atmospheric air is to be used, state temperature in ° F., and humidity as a percentage. If these vary much, enclose yearly charts for both.

*Water*. Source, chemical analysis, hardness factor, condition, quantity in gallons per hour and temperature in ° F. If temperature varies greatly over the year, give a yearly chart.

14. If so, send fully dimensioned plans and elevations of existing building. This should be so detailed that it is possible to calculate the strength of all floors, ceilings, walls, columns, etc.

15. If so, enclose data sheet with answers to relevant questions.

16. This includes any regulations governing noise, vibration, smoke, dust, etc., height or design of buildings which may be used, ancient lights, etc.

17. Is the estimate to include proposals for packing and dispatching the finished material ?
18. Are extensions to be provided for ?
19. State full extent of the material to be covered by the tender.
20. Enclose scale plan of the proposed site.

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17. If so, state form in which it is preferred material should be sent away.

18. State to what extent the plant is to be finally extended. This can, perhaps, best be done by saying plant is eventually to be capable of turning out such and such a percentage (Ex. 150 or 200 per cent) of the output, given in answer to question 3.

19. Is erection to be included ? Give details asked for under general data sheet. Where is tender to start—

(*a*) At boiler plant with all its accessories.
(*b*) At prime mover with all its accessories.
(*c*) At electric generator with all its accessories.
(*d*) At transmission.
(*e*) At and including electric motor with all its accessories.
(*f*) At machine.
(*g*) Are belts, ropes, etc., cables, etc., to be included.

The answer to this question cannot be too clearly or fully answered.

20. This should show proposed or actual position of the building (and neighbouring buildings, when this is important), railway connections, sidings, etc., position of river, canal, all roads, water supply, etc.

## FAN

1. State quantity of free air to be delivered in cubic feet per minute. Normal. . . . Maximum . ..
2. State condition of the air to be handled.
3. What air pressure is required at fan outlet in inches w.g. ?
4. Is the quantity of gas delivered to be varied ? If so, how often, for how long, and between what limits ?
5. State vacuum to be maintained at fan inlet, inches w.g.
6. For what duty is the fan required ?
7. If for a mine, state the equivalent orifice of the mine.
8. How is the fan to be driven ?
9. State nature of drive preferred.
10. Enclose dimensioned sketch showing proposed layout.

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1. State how long maximum demand may last. If, as sometimes happens in the case of mine fans, the fan is only to be partially loaded for some months at commencement of use, this fact should be stated. (See also question 4.)

2. State altitude of site and average percentage of humidity of air. If it is carrying solid matter, such as wood shavings, flour, sand, etc., give full particulars of the material carried. In the case of fans dealing with gases other than air, give following additional particulars, name, specific gravity at 60. F. and 760 mm., whether it has any corrosive action on steel, etc., temperature of gas at fan inlet in ° F.

5. This is important when the fan is to be used as an exhauster. If the air extracted is not delivered into free atmosphere, question 3 must also be answered.

6. Mine ventilation, heating and ventilating installation, gas or oil burning installations, conveyance of sawdust, shavings, flour, etc.

8. From transmission, state speed. If by steam-engine, gas or oil engine, steam turbine or electric motor, enclose completed data sheet.

9. Direct-coupled, belt, rope or chain.

10. This should show position of fan, engine, etc., and apparatus to be fed, with all connecting pipes and their dimensions.

## FAN, MECHANICAL DRAUGHT

1. State type and size of boilers and number simultaneously in operation.
2. Give fire grate area and heating surface for each boiler in square feet.
3. State type and make of mechanical stoker used.
4. State fuel consumption required in lb. per hour. Average.... . Maximum . . .
5. What is the weight of water to be evaporated from and at 212° F. in lb. per hour? Average .... Maximum . . .
6. Give full particulars of the fuel to be employed.
7. What type of fan is preferred?
8. What form of drive is to be provided.
9. Give particulars of flues and chimneys into which fan will drive the gases.
10. State fuel consumption at present in lb. per hour. Average. Maximum
11. State percentage of $CO_2$ in flue gases at the base of the chimney when burning the average and maximum quantities of fuel respectively given under question 10. 1 . 2 .

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7–13. Data sheet for "fan" may also be used in place of the above if the necessary particulars are known, but questions 7 and 13 above should also be given.

4–5. This may be given for each boiler (assuming all are equally loaded) or the total from all the boilers, but the answer should clearly indicate which.

6. This should include kind of fuel (coal, coke, etc), class of fuel (nuts, peas, breeze), calorific value of fuel, and chemical analysis.

7. Forced or induced draught fans or "Pratt System." In the last case the answers to (4) and (5) should be per boiler. In the case of the "Pratt System," state whether "in circuit" or "out of circuit" pattern is desired.

8. Transmission (state speed), steam-engine, electric motor, etc. Give particulars asked under separate data sheets.

9. This should include length, breadth, and height of flues, internal diameter of chimney at bottom and top, and height of chimney. All dimensions in feet.

12. State draught in inches w.g. at the base of the chimney when burning the average and maximum quantities of fuel respectively given under question 10. 1 2 .
13. In the case of induced draught fans, give the temperature of the flue gases at the point where the fan will be installed, in ° F.
14. Is an economizer used ? If so, give particulars.
15. Give a detailed dimensioned sketch showing proposed site of fan.

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15. This should show layout of boilers, super-heaters, economizers, flues, and chimneys, the proposed site of the fan should be indicated as well as the layout, and dimensions of the air ducts to the boilers.

## FILTER, AIR

1. State the volume of air to be filtered in cu. ft. per min.
2. State altitude at which the filter will be erected.
3. State temperature and humidity of air to be filtered. Average .. . . Maximum ..
4. Is the air to be cooled as well as filtered ? State minimum temperature required.
5. Is the air to be heated as well as filtered ? State maximum temperature required.
6. For what purpose is the cleansed air to be used ?
7. What type of filter is preferred ?
8. What form of filter is desired ?
9. What initial pressure drop through the filter is allowable, in inches w.g. ?
10. In the dry air filter should the timber be impregnated to resist fire ?
11. In the wet air filter, is a suitable water supply available ?
12. Is a fan to be supplied for driving air through the system ?

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3. If the air contains objectionable chemical fumes or chemical dust liable to injuriously affect the filter, this should be stated. Whenever possible, annual charts of temperature and humidity should be sent.

6. For the ventilation of hospitals, schools, or other buildings, etc., in this case give full particulars of the processes carried on in the rooms and the average amount of heat given off in B.Th.U. per hour ; or for cooling generators, motors, etc., or for cleaning air to compressors.

7. Wet, dry, visco, etc.

8. Is the filter to be completely enclosed in a wooden casing, or semi-enclosed (only the pure air chamber being totally enclosed), or open type for building in a brick or concrete housing ?

9. For cooling generators and motors this is usually ca. 0·05 in. w.g. For air compressors it may be higher.

11. If so, state source, pressure of supply and maximum temperature. If not under pressure, is power available for driving the circulating pump. If belt drive from existing transmission give speed, diameter of pulley and position of shafting relative to proposed position of filter. If electric drive is to be employed, state system, voltage, and frequency of the supply available.

12. Give same particulars as for drive in question 11.

13. Give a dimensioned sketch showing space available for filter.

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13. The position of the machinery for which the air is required should also be shown, together with the position of the air ducts leading to and from it. In the case of the ventilation of buildings, plan and elevations should be submitted, showing proposed run and size of ducts to be used.

## FILTER, LIQUID

1. State the quantity of liquid to be filtered in gal. per hour. Average .. Maximum ...
2. State nature of liquid to be filtered.
3. Is the filter to operate continually ?
4. State number of hours that maximum demand will last.
5. Give source of supply of the liquid.
6. For what purpose is the filtered liquid required ?
7. What is the head on the raw liquid at the filter inlet in feet ?
8. Is the filtered liquid to be delivered to a tank or into mains ?
9. If to a tank, give the size in gallons, and the height of the bottom of the tank above ground level in feet.
10. If into mains, state pressure in mains in lb. per sq. in. abs., or inches w.g.
11. Enclose chemical analysis of liquid to be filtered.
12. Give dimensioned sketch showing proposed layout.

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See B.S.S., No. 189.

2. Water, spirits, etc.
5. River, lake, canal, etc.
6. Drinking, potable, washing, cooling machinery, boiler feed, etc.
7. If the water is delivered to the filter under gravity, give the height of the water level at the point of supply above the ground level at the proposed site of the filter in feet, and the diameter and length of the piping bringing the water down to the filter, both in feet. If the water is delivered to the filter from a pump, the size, type, speed, and head against which it is designed to work should be given, together with particulars of the piping between pump and filter.
12. This should show proposed arrangement and sizes of piping.

## FILTER, OIL

1. State the quantity of oil to be filtered in gal. per hour.
2. Give particulars of the oil to be filtered.
3. What is the temperature of the oil at filter inlet in ° F. ?
4. With what type of machine is the oil used ?
5. If used in connection with machine tools, give the nature of the material being worked.
6. Is water liable to get into the oil ?
7. How is oil delivered to filter ?

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2. Name of oil, specific gravity, and viscosity at 60° F.
4. Open or enclosed. In the case of open type machines, is there much dust present in the surrounding atmosphere ?
5. Brass, bronze, aluminium, cast iron, steel, etc.
6. From the oil cooling system, etc.
7. If oil is to be pumped to filter, and pump is to be included, state system, voltage, and frequency of electric supply available, and enclose dimensioned sketch showing proposed position of filter and all points from which oil is to be collected. Full data to enable friction head to be calculated should be given.

## FORGE, DROP

1. State weight of tup required in cwt.
2. Give dimensions of piece to be forged, in inches.
   Maximum . Average . . . Minimum . ........
3. Give weight of piece to be forged, in pounds.
   Maximum . . ..Average.. . . . .. Minimum . . .
4. Give particulars of the material to be forged.
5. What class of article will be handled ?
6. State maximum output required for forge in lb. per hour.
7. State type of forge desired.
8. How is forge to be driven ?
9. Give particulars of air supply available.
10. Give particulars of steam supply available.

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This sheet can also be used for power-driven hammers, in which case question 9 or 10 must be answered.

1. Exclusive of the weight of the die. The weight of tup should be given if known, but will be controlled by the output required as detailed below.
2. This should state maximum, length, breadth, and thickness which may occur. They need not occur together, but are asked for to check whether they affect any of the forge dimensions.
4. State composition of steel.
5. Motor-car axles, scissor blades, knives, etc.
7. Drop forge, air hammer, steam-hammer. State whether overhanging with or without slides or arch form is desired.
8. From transmission, state speed ; electrically, state system, voltage, and frequency.
9. Quantity in cub. ft. per minute, pressure in lb. per sq. in. g.
10. Quantity in lb. per hour, pressure in lb. per sq. in. abs., and temperature in ° F.

## FOUNDATIONS

1. Enclose dimensioned drawing of the apparatus for which the foundation is required.
2. State of what material foundations are to be made.
3. State total weight of the apparatus.
4. State weight on each support if it is not equally distributed over the whole base.
5. At what speed does the machine run ?
6. Does the work in the machine give rise to heavy shocks ?
7. State nature of drive employed.
8. Must special precautions be taken to avoid the transmission of vibration ?
9. Enclose dimensioned sketch showing position and size of foundation bolts to be used.
10. Give full particulars of the soil on which the foundation is to rest.
11. Enclose dimensioned sketch showing position of all machinery, columns, foundations, etc., in the neighbourhood of the proposed foundation.

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1. If pipework, etc., must come through foundations, their size and position must be indicated on the drawing. Any openings which have to be left for air ducts, cable-ways, other apparatus placed below main apparatus, etc., should be shown.

2. Brick, stone, concrete, ferro-concrete.

6. Such as occur in rolling mills, etc.

7. Belt, rope, chain, gear, etc., and indicate on which side of the apparatus the pull will come.

10. Name, rock, gravel, sand, loam ; give thickness in feet of each layer ; has the ground at any time been made up ? State depth of ground water-level measured from ground-level. Whenever possible, enclose a sectional sketch of the land on which the foundation will be built. In the case of all important machinery this should go down at least 20 ft., or till a suitable layer is reached.

11. The size of all existing foundations near to the proposed site should also be given.

## FURNACE, CALCINING

1. State maximum quantity of ore the furnace is to treat per day.
2. Give full particulars of the ore to be treated.
3. State what impurities are to be removed from the ore.
4. How is furnace to be fired ?
5. Give particulars of the fuel to be used.
6. Give particulars of any compressed air supply available.
7. Is automatic feed and delivery of the material desired ?
8. Are the by-products to be recovered ?
9. Is it desired to be able to regulate the temperature ?
10. Enclose fully-dimensioned sketch of layout.

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This data sheet can also be used for lime furnaces.

1. State number of working hours per day.
2. Name, size, chemical analysis. Whenever possible, submit a sample.
3. Carbon, dioxide, sulphur, arsenic.
4. Coal, coke, powdered fuel, gas, or oil.
5. Size as fired, calorific value in B.Th.U. per lb. or cub. ft.
6. Quantity in lb. per hour, pressure in inches w.g.
8. As for instance, the recovery of $CO_2$ from chalk burning in sugar factories.

## FURNACE, CUPOLA

1. State maximum output of molten metal required, in tons per hour.
2. State maximum weekly output of castings required, in tons.
3. Give full particulars of the material charged into the furnace.
4. State maximum weight of individual casting to be made, in pounds.
5. What class of casting is to be turned out ?
6. Is the furnace to be fitted with a drop bottom and a receiver ?
7. Is the furnace to be fitted with a charging platform ? Give particulars.
8. Is the furnace to be loaded by hand or mechanically ?
9. Is a spark arrester to be supplied ?
10. Is a suitable supply of air available ? Give particulars.
11. Is a blower to be included ?
12. State any accessories required.

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2. State also number of working hours per week and number of hours in which metal will be cast.
3. State quality of material and percentage of each material used. (Such as haematite, steel scrap, cast-iron scrap, etc.)
4. For what purpose are the castings to be used ?
7. Is it to be supported from foundry wall or independent ? State what weight it will have to carry, state any special requirements as to its size.
11. If so, give particulars as to how it should be driven ; if from existing transmission shaft, state speed in r.p.m. ; if by an electric motor, state system, voltage, and frequency.
12. Chimney hoist, piping, etc.

## FURNACE, ELECTRIC, HARDENING

1. Give particulars of the material to be dealt with.
2. Give dimensions of the largest piece, in inches.
3. What is the daily output desired? Weight in pounds..... . Quantity in number of pieces ...... .. . ... .
4. State number of working hours in which this output is required.
5. What is the maximum temperature required in ° F.?
6. What is system, voltage, and frequency of available supply?
7. If only A.C. is available, can the furnace be connected across one phase?
8. In case of small supply station, state total output of generators in kW.

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Can also be used for annealing, tempering.

1. This should state class of steel to be hardened.

2. If the dimensions of the largest piece to be handled differ materially from that of the average sized object, give the dimensions of the latter as well.

3. In the case of wire, state total length to be dealt with per hour in feet.

6. It is improbable that a furnace may be connected across one phase of a three-phase supply and, consequently, in this case, a special generator will have to be included in tender.

8. State whether supply is private or public, from generators or transformers. Also give some particulars of the other apparatus on the same circuit as the furnace, so that some idea may be formed as to whether it will be influenced by the action of the furnace.

## FURNACE, HEAT TREATMENT

1. State size of furnace required.
2. Give particulars of the articles to be treated.
3. State the maximum number of the above articles to be treated at one heat.
4. Give particulars of the material of which the articles are composed.
5. State maximum temperature required in ° F.
6. How is the furnace to be fired ?
7. Give particulars of the fuel to be used.
8. Is compressed air available for spraying the fuel ? Give particulars.
9. What type of furnace is preferred ?
10. Is furnace to be complete with oil tank ?
11. Is furnace to have an air heater ?
12. With what metal are the articles to be coated ?

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For hardening, annealing, tempering, coating.

2. This should include dimensions and weight in lb. per piece.

3. If various articles are to be treated, the answer to this question should give the maximum weight which the furnace will ever be likely to handle. Also state maximum number of articles to be treated in an hour. In the case of wire, state number of yards to be dealt with per hour.

2–3. Will give the size of the furnace. Question 1 need not then be answered unless a particular size, similar to others in use, is required.

4. Steel, etc., and quality of steel.

6. Pulverized fuel, coal, oil, or gas.

7. Class and calorific value in B.Th.U. per lb.

8. Pressure lb. per sq. in. abs., or inches w.g., and quantity in cub. ft. free air per minute, unless supply is abundant.

9. Single or twin chamber, regenerative, etc.

12. Only applies to coating furnaces, zinc, lead, tin, etc.

## FURNACE, MELTING

1. State maximum output of molten metal required in lb. per hour.
2. State maximum weekly output of castings required in tons.
3. Give full particulars of the material to be melted.
4. State maximum weight of individual casting to be made in pounds.
5. What class of casting is to be made ?
6. State how furnace is to be fired.
7. Give particulars of the fuel to be used.
8. How is fan to be driven ?
9. State any accessories required.

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2. State also number of working hours per week and number of hours that metal will be cast.
3. Name, white metal, gun-metal, bronze, brass, copper, aluminium, etc., also state its composition.
4. If this occurs only very occasionally, state average weight of a run of castings.
6. Coal, gas, or oil.
7. State class, size, and calorific value in B.Th.U. per lb. or cub. ft.
8. From transmission, state speed ; or from electric motor, state system, voltage, and frequency.

## FURNACE, REFINING STEEL, ELECTRIC

1. What type of furnace is desired ?
2. What form of furnace is preferred ?
3. State the furnace capacity required in tons.
4. Give the output required from the furnace in tons per month.
5. Give full particulars of the steel to be refined, including a chemical analysis.
6. For what purpose is the steel required ?
7. Will the steel be put into the furnace cold or melted ?
8. Is the furnace to be fixed, rotating, or tippable ?
9. How are the electrodes to be regulated ?
10. Give particulars of water supply available for cooling the electrodes.
11. State the system, voltage, and frequency of the electrical supply.
12. Enclose dimensioned sketch showing proposed position of furnace and point of supply.

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1. Induction, arc, or resistance.

2. Kjellin, Rochling-Rodenhausen ; Stassano, Heroult, Girod, Keller, Nathersius.

3. That is, weight in tons of the charge to be melted.

4. State the number of working hours per month, and longest continuous period of use of the furnace in hours.

5. This should include an analysis of the steel used, as well as of the finished product.

10. Quantity in gallons per hour and quality, i.e. soft or hard, etc.

11. If the supply is private, give full particulars of the supply station, number of generators, size of each in kW., overload capacity of each, prime mover, average daily load curve. The price per kWh. of the electricity may also be given to enable economy of furnace to be checked.

12. Carefully-dimensioned plans and elevations of the room to take the furnace are very important, as mistakes in estimating the lengths of leads required may make considerable variations in the price.

## FURNACE, REHEATING

1. Give dimensions of material to be reheated.
2. State shape of material to be handled.
3. State number of billets to be reheated per hour.
4. Is material hot when placed in the furnace? State temperature in ° F.
5. Give weight of billet to be handled, in pounds. Maximum..... . Average..........
6. State maximum temperature required in ° F.
7. What type of furnace is required?
8. State how it is to be fired.
9. Is a suitable supply of air for gas firing available? Give particulars.
10. Give particulars of the fuel to be used.
11. State how furnace is to be charged.
12. Are water-cooled rails to be supplied? If so, give particulars of water supply available.
13. State how reheated material will be handled.
14. In the case of a soaking pit, is the lid to be lifted clear or pushed to one side?
15. Enclose dimensioned drawing showing proposed layout.

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1. Maximum dimensions should be given. If these are exceptional, give dimensions of average run as well.
2. Rectangular or cylindrical.
7. Horizontal, vertical soaking pit, horizontal continuous feed, regenerative (all types can be made so).
8. Coal, coke, coal dust, gas, combined coal and gas.
9. Pressure in inches w.g., quantity in lb. per hour, and temperature in ° F. if air is heated by waste gases.
10. Name, size, etc., calorific value in B.Th.U. per lb. or cub. ft. In the case of gas firing it is assumed that there is a suitable gas supply. If not, state whether gas producer is to be offered.
11. By hand or by furnace charger, if latter enclose completed data sheet for ingot pusher.
12. Pressure in lb. per sq. in., and quantity in lb. per hour.
13. End removal or by side doors.

## GAUGE

1. State what is to be measured by the gauge.
2. State the working values between which the gauge will be required to record. Maximum...... Average.........
3. What is the minimum value of which it is important to have a record ?
4. What size of gauge is required ?
5. What form of gauge is desired ?
6. If recording gauge is required, state speed of chart preferred.
7. With what liquid is the gauge to be used ?
8. Is an electric alarm attachment required ?
9. Are special precautions to be taken against vibration ?
10. State temperature of the liquid to be gauged.

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1. Pressure, vacuum, draught, altitude, density, humidity.
2. The values should be given in lb. per sq. in. gauge for pressure, inches of mercury for vacuum, inches w.g. for draught, feet for altitude, in 32nds for density, in per cent for humidity.
4. 6 in., 8 in., or 12 in. dial.
5. Indicating or recording, switchboard or wall mounting, mounting direct on boiler, etc.
6. 1, 12, or 24 hour or 7 day chart.
7. Air, flue gas, steam, ammonia, etc. This question is very important, as if the gas has a corrosive action on the metal parts, special precautions will have to be taken to protect them.
9. Such as occur in motor-cars, lorries, aeroplanes.
10. Only necessary if the liquid comes into contact with gauge, or the temperature is very high or very low.

## GEAR, HAULAGE

1. State the quantity of material to be handled in tons per hour. Average . . . Maximum. . . .
2. What material is to be hauled ?
3. If the load is made up in trains, what is the net load in tons per train ? Average. . . Maximum . . .
4. State net weight of material per tub in tons.
5. State weight of empty tub in tons.
6. If men are to be carried, state number of men per train, and how frequently they are to be carried.
7. State length in yards and gradient in per cent of the road.
8. Give profile map showing distribution of the gradient along the road.
9. Is the road single or double ?
10. What type of haulage gear is preferred ?
11. State speed of rope desired in feet per minute.
12. What drive is available for the gear ?
13. Give detailed dimensioned sketch showing proposed layout of the haulage gear.

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1. State how long the maximum demand is likely to last.
2. Coal, iron ore, zinc ore, clay, etc. ; also give weight of material in lb.-cub. ft.
7. It will be assumed the tubs are to be hauled the full length of the road, unless otherwise stated.
8. This should show position of all curves and radius of them, length of each gradient, amount of each gradient expressed in per cent., and position on the road. If such a sketch is not available, the position of the maximum gradient with reference to the haulage gear should be stated, i.e. commencement of maximum gradient of.... ..per cent is .......yd. from gear. The sketch should also indicate which way along the road the load will be drawn.
10. Main and tail, endless or single rope.
12. Steam, electric, air, etc. Give data asked for under data sheets for steam-engine, electric motor, etc. ; if by air pressure, state average and maximum pressure in lb. per sq. in. abs. at the haulage gear engine. If the mechanical part of the haulage gear is already available and only the drive for it is to be offered, the following additional particulars should be given. The diameter in feet and size of grooves in inches of the rope pulley if used, or type (worm, spur, etc.), and ratio of gearing employed.
13. State whether above or below ground.

# GENERATOR, ELECTRIC

1. State maximum continuous output required from generator in kW.
2. What system of supply is desired ?
3. Give type of generator desired.
4. What is the frequency of supply ?
5. What voltage is required at the generator terminals?
6. State voltage regulation required.
7. State power factor expected at full load.
8. Give full particulars as to the nature of the load on the generator.
9. State speed at which generator is to be driven in revs. per min.
10. Is current for excitation available ?
11. If available, state voltage and amount available in kW.

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See B.S.S., Nos. 168, 169, 225, 226.

1. In the case of variable voltage machines, state whether this output is to be maintained over whole range. If not, give particulars as to the output required at the various voltages.

2. Continuous current, two- or three-wire (for three-wire system see also under static balancer), single-phase, two-phase, three- or four-wire ; three-phase, three- or four-wire.

3. Shunt, series, or compound ; in latter case state whether level or over-compounding is required, and degree of compounding required. If shunt and series windings are to be used separately, state voltage required under each. Synchronous or induction generator.

5. Normal full-load voltage should be stated.

6. If not specified, maker will assume his standard.

8. In specifying the nature of the load, it should be stated whether the load is traction, predominatingly motor or lighting, electric furnace, etc. ; in the case of a mixed motor and lighting load the approximate percentage of motor to total load should be given. When this percentage is large, it should be stated whether the average size of the motor is large or small, and for A.C. circuits whether all the motors are induction. If there are synchronous motors on the line, are any of them used for P.F. correction and, if not, could any be so used ? The nature of the load will more or less fix the P.F. unless a synchronous condenser is used.

10–11. It is only necessary to specify this in the case of A.C. generators, or in some special D.C. machines where separate excitation is necessary. When no excitation is available, is an exciter to be offered and, if so, is it to be direct-coupled to the generator or separate therefrom ? In the latter case, how is the exciter to be driven ? Give separate answers for the exciter to questions 9, 12, and 13.

12. How will the generator be driven ?
13. In which form is the generator to be delivered ?
14. Is special insulation necessary ?
15. Is the generator to work in parallel with others ?
16. If for parallel operation, state the fly-wheel effect provided in the prime mover in ft.$^2$ tons.
17. State temperature rise which is not to be exceeded.
18. State overload capacity required.
19. Is the neutral point to be available ?

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12. State prime mover to be used. In the case of water turbine drive with horizontal shaft, is there any end-thrust from the turbine to be taken up ? State also whether generator is to be direct-coupled to the prime mover, or to be driven through belt, rope, chain, or gear.

13. For ordinary drives it should be stated whether the machine is required with—
(*a*) Standard pulley.
(*b*) Free shaft end.
(*c*) One bearing, short shaft and half coupling.
(*d*) No bearings or shaft.
(*e*) Pedestal bearings.
(*f*) Vertical shaft.

The form used will mainly depend on the prime mover and method of drive chosen, but is also affected by the size of the unit. Where the generator is to be delivered in form (*d*) and is intended for erection direct on prime mover shaft, state whether rotor is to be in two halves or not. If pedestal bearings are required and the design of the machine allows of this, it should be stated whether the pedestal bearings are to be on separate sole-plates, or two on a common bedplate with the generator, or three (that is, including an outboard bearing where a large pulley is required) on a common bedplate. In water turbine drives, where the shaft is vertical, it should be stated how many bearings are required and whether they have to carry the whole weight of the generator rotor and a part of the turbine rotor weight, or whether the turbine bearings will carry a part of the generator rotor weight. If the generator bearings have to carry additional weight the amount should be stated.

If the generator is totally enclosed, as is always the case in turbo-generators and frequently the case in chemical works, the amount of cooling air in cub. ft. per minute to maintain the machine temperature at the figure given in answer to question 17 should be asked for from the maker, in order that a suitable air filter may be chosen.

14. To resist moisture, chemical fumes, or dust.

15. Where the generator has to work in parallel with others, the output, prime mover, voltage regulation, and cyclic irregularity of each of the other generators should be given. Do all of these sets work in parallel with one another ?

16. The maximum fly-wheel effect ($WR^2$) which can be provided in the prime mover should be given.

17–18. If no figures are given, it will be assumed that standard practice will be acceptable.

20. In the case of a turbine drive, state maximum overspeed the generator will be expected to withstand.
21. State what accessories are to be included.

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21. Shunt regulators, standard pulley, foundation bolts, slide rails, etc.

## HEATER, AIR

1. State quantity of air to be heated in cu. ft. per min.
2. What is the final air temperature required in ° F. ?
3. For what purpose is hot air to be utilized ?
4. What system of heater is to be employed ?
5. Give particulars of any steam supply available.
6. Give particulars of any exhaust gases available.
7. Give particulars of electricity supply available.
8. Enclose dimensioned sketch showing proposed layout.

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See also data sheet for heating installation and ventilating installation.

1. Or other gas. If this cannot be done, give full particulars of the apparatus with which the hot air is to be used, quantity of material to be dried, etc.
2. It will generally be assumed that inlet air temperature will be 60° F. Should temperature be much below this, state exact inlet temperature.
3. Heating buildings, drying material, air supply to boilers, etc.
4. Steam, exhaust gas, or electric.
5. Live or exhaust (in the case of exhaust steam, state from what source it is obtained), quantity available in lb. per hour, steam pressure in lb. per sq. in. abs., and temperature in ° F.
6. Source, quantity in lb. per hour, temperature in ° F.
7. System, voltage, and frequency.
8. Should show the space available for the apparatus, point of supply of steam, exhaust gas or electricity, etc.

## HEATER, FEED WATER

1. State quantity of water to be heated in gal. per min.
2. What is the inlet temperature of the water to the heater in ° F. ? Average. . . . . Maximum . . . . . . Minimum.. ...........
3. What is the water pressure at the heater inlet in lb. per sq. in. abs. ?
4. What is the boiler pressure in lb. per sq. in. abs. ?
5. Give particulars of the quality of and source from which the feed water is obtained.
6. State the temperature of the feed water at present entering the boiler in ° F.
7. How is the water at present fed to the boilers ?
8. What quantity of exhaust steam is available in lb. per hour ?
9. What machines supply this exhaust steam ?
10. Is the whole of the above quantity of exhaust steam available for feed heating ? If not, state quantity in lb. per hour that is available for this purpose.
11. Is hot water required for other purposes than boiler feed from this heater ?

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5. Has the water been treated ? If so, give particulars. If not, state source of supply and give hardness factor or chemical analysis.

6. If an economizer is used it will be assumed that the feed water heater delivers into the economizer. It should, therefore, be mentioned whether an economizer is to be used or not.

7. By pump or injector. In case of pump, state size, type, pressure of delivery and speed.

8. If it is not possible to give the quantity of exhaust steam available, full particulars of the machines supplying this steam should be given. This should include, number, size, type, cylinder dimensions, cut-off, speed and boiler pressure in lb. per sq. in. abs., etc.

10. When exhaust steam is required for heating or drying purposes, the amount required should be stated so that the net amount available for feed heating can be found.

11. This is not usual, but may arise. In this case the quantity of hot water required should be stated in gallons per hour.

12. What type of feed water heater is desired ?

13. Give dimensioned sketch showing space available for heater.

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12. State whether for separate erection or fixing in boiler shell ; whether steam is to pass inside or outside heater tubes, etc. If the heater is to be fixed inside the boiler shell the answers to questions 1–6 should only refer to each single boiler to which the heater is to be fitted, and in addition the following information given—

(*a*) Type and size of boiler.
(*b*) Size and shape of manhole.
(*c*) Clearance in inches between top water-level and boiler shell.
(*d*) Size and position of check feed valves.
(*e*) Sketch showing position of various boiler mountings, sectional elevations of boiler shell are desirable.

13. This should also show present layout of piping, with sizes.

## HEATER, WATER

1. State quantity of water to be heated in gal. per hour.
2. What is the water temperature at inlet to heater in ° F. ?
3. What is the final water temperature required in ° F. ?
4. Does the water flow through the heater continuously ?
5. Give dimensions of the tank in which ejector will be immersed.
6. Is exhaust or live steam to be utilized ?
7. Give particulars of steam supply.
8. Give dimensioned sketch showing space available for heater.

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7. State quantity available in lb. per hour, pressure in lb. per sq. in. abs., and temperature in ° F. In the case of exhaust steam, state from what apparatus it is obtained ; if it is oily, will this be objectionable in the case of an ejector heater ?

## HOIST, BLAST FURNACE, ELECTRICALLY DRIVEN

1. State type of hoist required.
2. State form of hoist desired.
3. In the case of an inclined hoist, how many loading stages are there at ground level ?
4. If a counterweight is used with a single-drum hoist, what is its weight in tons ?
5. In the case of a double-drum hoist, is it ever necessary, as an emergency measure, to work on one drum only ?
6. State net load in tons when hoisting ore alone and coke alone respectively. Ore.................. Coke..........................
7. State net load in tons when hoisting a mixture of ore and coke.
8. Are other loads besides these likely to be carried ? If so, give particulars.
9. What is the total weight, in tons, of ore and coke respectively to be hoisted per hour ? Ore..................Coke..................
10. In what order will the loads be hoisted ?
11. What is the total weight, in tons, of the dead load to be hoisted ?

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Whenever possible, the makers of the mechanical part should supply load and speed diagrams, as this will facilitate the calculations. Separate diagrams should be given for ore, coke, empty wagons, etc., and the data for which they are calculated, i.e. net weight of load, speed, number of journeys per hour, etc., noted on them. In calculating the power required during acceleration and retardation the whole of the mechanical parts should be included, with the exception of the motor armatures, which may be assumed to run at the mean speed obtained from question 35. The load diagrams should be plotted with time in seconds as abscissa and h.p. as ordinates ; and the speed diagrams with length of travel in feet as abscissa and speed in feet per second as ordinates.

1. Vertical or inclined.
2. Single or double drums.
10. That is, will a load of ore follow a load of coke alternatively, or will two or more loads of coke be run per one load of ore ?
11. Includes weight of all mechanical parts to be hoisted exclusive of load.

12. State weight of an empty wagon in tons.
13. State weight of an empty cage in tons.
14. How many wagons per cage are carried?
15. How many loads of ore and coke respectively will be hoisted per charge?
16. What is the length of a charge in minutes?
17. How many charges will be made per day of 24 hours?
18. Give vertical height of lift in feet.
19. For inclined hoists, give length of inclined plane in feet.
20. State hoisting speed required in feet per minute.
21. How many seconds pause is allowed between each journey?
22. Will the wagons be automatically tipped? If not, give particulars of proposed arrangement.
23. Give the dimensions of the drums, gears and pulleys in feet, and their fly-wheel effects in $ft.^2$ lb.
24. What is the efficiency of the driving gear?
25. What full-load motor speed, suitable for the mechanical gear, when running at constant speed is allowable? Minimum. ........ Maximum ..............
26. Is the load to be carried beyond the discharge stage?
27. If so, what safety arrangements are to be provided?
28. What is the length of run-out provided, in feet.
29. What type of control is required?
30. What is the position of the driver relative to the hoist? His position should be shown on the sketch.

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18. The vertical lift must be given for both vertical and inclined hoists.
19. Or state the angle the inclined plane makes to the horizontal.
21. This should be given separately: (*a*) loading; (*b*) unloading.
29. Is the control to be hand-guided by a depth indicator, or is the hoist to be automatically accelerated and retarded?

31. What pull in pounds, and stroke in inches is required for the manoeuvring brake ?
32. Will the emergency brake be operated by a brake magnet ? If so, give particulars of magnet required.
33. What reserve apparatus is to be provided ?
34. State system, voltage, and frequency of available supply.
35. In the case of an alternating-current supply, is continuous current available for the excitation of the motor generator ?
36. Give particulars of the power supply available.
37. Enclose dimensioned sketch showing proposed layout.

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32. See brake magnet data sheet.

33. That is, what reserve apparatus, such as motors, controllers, and brake magnets are to be provided, so that in the event of a breakdown the hoist can be immediately switched over on to reserve and continue running without shutting down.

36. This should include number of units in station, size of each unit, overload capacity of each unit, how driven, specimen of average daily load curve.

## IMPROVER, POWER FACTOR

1. What type of power factor improver is desired ?
2. Give full particulars of the motor with which it is to be used—
   (*a*) System, voltage, and frequency of supply.
   (*b*) Normal full-load output of motor in h.p.
   (*c*) Rotor current at full load.
   (*d*) Rotor voltage at standstill.
   (*e*) Normal full-load power factor.
   (*f*) No. of phases for which the rotor is wound.
   (*g*) Full-load slip.
   (*h*) Maker's name, and motor number.
3. Is the motor fitted with brush lifting and short-circuiting device ?
4. Is the speed of the motor to be varied ?
5. To what extent is the power factor to be improved ?
6. Through what range of load is this improvement desired ?
7. What is the nature of the load on the motor ?
8. Does the motor work as a generator at any time ?
9. Is there any objection to the increased slip caused by the improver ?
10. Is D.C. available for excitation purposes ? Give particulars.

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1. Static condenser, synchronous condenser, asynchronous motor with D.C. excitation (these three methods are used for general improvements of line power factor); three-phase commutator motor or vibrator, in rotor circuit of main motor (used for improvement of the power factor of an individual motor).

2. If the power factor of an existing motor is to be improved, it is important to be able to check whether the rotor can carry the larger currents required.

4. Power factor improvement with motors for speed variation cannot be satisfactorily accomplished.

5. Say, from normal full-load power factor of motor to 0·9, or whatever figure is required.

6. Say, three-quarters-full load, etc. This is important, as some types of power factor improvers can only be used over a limited range of load.

7. Steady, fluctuating, or impulsive, reversing, frequent starting and stopping.

8. For purposes of breaking, etc.

11. Give particulars of the surroundings in which the improver will be erected.
12. Is there any reduction in the price of electricity on account of improved power factor? Give particulars of the tariff.

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11. Damp, dusty, fumes, etc.
12. Enables the question, "Whether it is economical to use a power-factor improver," to be checked.

# INJECTOR, WATER

1. What is the quantity of water to be delivered in gal. per hour ?
2. What is the boiler pressure in lb. per sq. in. abs. ?
   Maximum. . . . .. . Minimum.. .. .
3. Against what suction head, in feet, has the water to be lifted ?
4. What is the temperature of the water in ° F. ?
5. Is a supply of exhaust steam available for operating injector ? Give particulars.
6. Enclose a dimensioned sketch showing proposed layout.
7. State against what total head the water is to be delivered, in feet.

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This sheet may be used for water injector for supplying water to boilers, etc., where the head against which the water must be delivered is the boiler pressure given under question 2 ; or it may be used for supplying water to a tank, etc., in which case question 7 must be answered in addition. In this case also give diameter and lengths of delivery pipe. This sheet may also be used to cover ejectors, for emptying sumps, tanks, etc. In this case, if a liquid other than water is to be handled, give full particulars, name acid, or alkaline, strength of solution and density.

3. The length and diameter of the suction pipe should be given, together with the number of bends. The suction pipe should be as short as possible, as with hot water the injector will only lift very short distances. If feed water flows from an overhead tank, state vertical distance in feet between water-level in tank and centre of injector. If a supply is taken from town mains by the injector this should be stated, and the water pressure in the mains stated in lb. per sq. in. abs.

4. For satisfactory operation of steam injectors, the temperature of the feed water should not exceed 120° F.

5. State source of exhaust steam, weight available for the injector in lb. per hour, and pressure in lb. per sq. in. abs., if live steam (particulars of which are given under (2) ) is not to be used.

6. This should show proposed position of injector, feed tank, or hot-well point from which steam will be taken, and lengths and heights of feed water pipes.

## INSTALLATION, FIRE EXTINGUISHING

1. Give a full description of the premises to be protected.
2. Give full particulars of the work carried on on each floor.
3. Give particulars of any water supply available.
4. If this should not be satisfactory, state how pump should be driven.
5. State any special regulations governing fire in above class of building.
6. Enclose dimensioned plan and elevation of building.

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See B.S.S., No. 138.

1. This should state nature of building, stone, brick, ferro-concrete, etc., nature of walls, tile, plaster, and lath, hollow concrete brick, wooden, etc., nature of floors, wood, tile, etc. If ship, steam or sailing, wooden or steel.

2. This should state nature of work, cotton-spinning mill, wool-spinning mill, weaving shed, garage, paint works, petrol store, wood-working shop, etc.

3. Head in feet, quantity in gallons per minute.

4. From transmission, state speed, electric motor, etc., enclose data sheet.

6. This should show area of floor, height of ceiling, ceiling construction (separate sectional drawing should be given), position of all stairways, lift or hoist shafts, existing ventilating ducts, position of all water supplies, etc.

## INSTALLATION, HEATING

1. Give an accurate description of the work carried on in each room to be heated.
2. State air temperature which has to be maintained in the rooms, ° F.
3. State external air temperature in ° F. Maximum .. . ... .. Minimum .. . Average . . ..
4. What type of radiator is preferred ?
5. What type of installation is preferred ?
6. Is a separate heating installation to be provided for each building or floor ?
7. Is a supply of hot water required in addition to heating ?
8. Give amount of hot water required and for what purpose used.
9. State during what hours heating is required.
10. Is a steam supply already available ? If so, give particulars.

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See B.S.S., Nos. 40, 59, 78, 154.

1. Cotton spinning, weaving, machine shop, offices, hotels, dwelling house, etc.

3. Indicate also in a concise manner the nature of the climate, whether subject to long spells of cold weather, very windy and exposed, etc.

4. This will, to some extent, be fixed by work done in room ; for industrial purposes, state whether plain or ribbed ; for private purposes whether open or concealed, and type of finish required. If there are any special wishes as to the position of the radiators, their proposed position should be indicated in plans.

5. Low- or high-pressure hot water, steam.

By means of radiators in the rooms to be heated, or by central heater supplying warm air to the rooms. Although not often used for the purpose of heating buildings or shops, flue gases or the exhaust gases from gas engines are sometimes used in conjunction with central air heater. If either of these gases are to be used, state their source, indicate position of boiler or gas engine on plan, state gas temperature in ° F. at boiler end or exhaust flange, indicate on plan position of chimney suitable for taking the gases away.

8. If this is not known, state number of baths in house and approximate number of times each is used per day, number of hot water taps, hot water demand in kitchen for washing, etc., hot water demand for cleaning purposes (floors, tables, etc.), hot water demand for laundry. The position of all baths, taps, etc., should be shown on plans and elevations.

10. State from what source obtained, boiler, bleeder turbine or engine, etc., live or exhaust, in the latter case state whether oil separators are already in

11. If not, indicate on plan where boiler is to be placed, show any existing chimney which may be used, and indicate position of water supply and drains.
12. Give particulars of water supply available.
13. Is a ventilating system to be combined with the heating installation ?
14. Enclose fully-dimensioned plans and elevations of all buildings, rooms, etc., to be heated.
15. Indicate on a separate plan the north direction. and show all surrounding buildings.
16. State height of each of these buildings and whether heated or not.
17. Give full description of all walls, floors, basement, roof, windows and doors.

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exhaust line or must be included in tender, quantity in lb. per hour, pressure in lb. per sq. in. abs., and temperature in ° F. State distance source of steam is away from the building in feet.

11. The free area of the chimney in sq. ft. should be stated as well as particulars of any other plant using the chimney. Indicate size of drain and give particulars of other plant using it.

12. Source, hardness factor, quantity in lb. per hour, pressure in inches w.g.

13. If so, enclose separate completed data sheet.

14. These should show position of all doors, windows, or other openings, chimneys, drains, incoming water supply, incoming steam supply and proposed position of boiler, radiators, or central heater, etc.

15. This should be to scale, but need not be to the same scale as plans given to question 14.

16. If the buildings are not heated throughout, indicate which portions of them are heated.

17. This should include for walls and floors—
(*a*) Construction, brick, hollow tile, ferro-concrete, etc.
(*b*) Thickness.
(*c*) Interior finish, bare, plaster, paint.

Basement—
(*a*) Construction of floor.
(*b*) Thickness of floor.
(*c*) Can basement be deepened to take boiler if necessary ?
(*d*) Depth of water-level.

Roof—
(*a*) Construction of ceiling.
(*b*) Thickness.
(*c*) General roof design.
(*d*) Any openings in roof.

Windows—
(*a*) Size.
(*b*) Single or double.
(*c*) Type.

Doors—
(*a*) Size.
(*b*) Construction.
(*c*) Single or double.

## INSTALLATION, LIGHTING, ELECTRIC

1. Enclose dimensioned drawings of the areas to be lit.
2. What is the class of building in which the installation will be erected ?
3. Is the building already up ?
4. Give following particulars of the ceiling—
   - Height in feet.
   - Colour.
   - Type.
   - Depth of girders in inches.
   - Arrangement of ceiling windows, if any.
5. Are there any obstructions between the ceiling and the working plane ?
6. What is the colour of the walls ?
7. Give particulars of the furniture or machinery in the area to be lit.
8. What class of work is to be carried on in the area to be lit ?
9. What type of lamp is preferred ?
10. What type of wiring is desired ?
11. What system of illumination is preferred ?
12. Is the wiring to be buried or on the surface ?
13. What is the system, voltage, and frequency of the supply ?

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See B.S.S., Nos. 31, 33, 67, 73, 88, 97, 98, 161.

If preferred, the position and size of lamps, plugs, switches, etc., required may be marked on the plans submitted, but it is preferable to allow estimator to settle these particulars.

1. These should be for each floor, and should show the position of all windows, doors, pillars, columns, etc.

2. New or old, brick, stone, concrete, tile, walls, etc.

4. Type, i.e. whether of concrete, tile, lath, etc., when possible a sectional sketch of the ceiling should be given showing position of girders, windows, etc. ; it is assumed that the top end of the girders are flush with ceiling surface. Wherever possible, an elevation of the trusses used should be given.

5. Such as cranes, overhead transmission, etc.

7. Is it near or far apart ? Is it high ? What is its colour, etc. ?

8. This should be fully detailed for each room, attention being particularly drawn to presence of dust, fumes, smoke, moisture, explosive gases, etc.

9. Vacuum tungsten, gas-filled, arc, mercury vapour, etc.

14. With what company will the installation be insured?
15. Is a good earth available? If so, indicate its position on the plan.
16. Is an emergency lighting system required?
17. Indicate on plan where any special switching is required.
18. State any special desires with regard to the finish of the fittings to be used.

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10. In heavy gauge conduit, tough rubber sheathing, stannos, etc.

14. The insurance company for the building should be given.

17. Indicate class of special switching desired, i.e. simple, all lights from two points, part on and off, etc. Are all switches to be concentrated at one point in a distribution board?

18. Submit sketch of special fitting required and give a description of its finish. If taken from a maker's catalogue, give list number in catalogue.

## INSTALLATION, METER TESTING

1. State type of meter to be tested.
2. State number of meters to be tested at one time.
3. Give particulars of the supply on which the meters are used.
4. State range of voltages required.
5. State range of currents required.
6. What type of standard instrument is to be used ?
7. State any special requirements.
8. Enclose dimensioned sketch of proposed layout.

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1. Ampere-hour or watt-hour meter ; electromagnetic, induction, electrolytic, etc. ; prepayment, etc. If single as well as polyphase meters are to be tested, this should be stated.

2. If these are not all of the same type, state number of each type to be tested, and whether more than one such group will be tested at one and the same time.

3. D.C. or A.C. ; single-, two- or three-phase ; three- or four-wire. State also if neutral point is available. It is assumed that this supply may be used for testing.

7. Pilot lamps to show what circuits are in use, integrating meter to register whole of energy used in the testing room, etc.

## INSTALLATION, TEMPERATURE CONTROLLING

1. State number of points at which the temperature is to be measured.
2. State temperature to be measured at each point ° F. Maximum......... Minimum.. .......
3. For what class of work is the installation required ?
4. What class of instrument is required ?
5. Will the instrument be subject to vibration ?
6. Give length of connecting cable required from each point to the control station in yards.
7. State length of these cables which are subject to excessive heat or exposed to weather conditions, in yards.
8. Is the installation to control the temperature automatically.
9. If so, give particulars of any electricity, water, or compressed air supply available.
10. Enclose dimensioned sketch of proposed layout.

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See also data sheet for pyrometer.

3. Furnace control, control of melting or boiling materials, flue gas control, control of room temperatures, etc. In all cases where temperatures over 212° F. have to be dealt with and it is necessary to use pyrometers, enclose completed data sheet for pyrometer. In other cases, it will be assumed that thermometers for wall fixing will be suitable, unless an automatic installation is required.

4. Fixed or portable, indicating or recording, combined indicating and recording. Must a separate indicating instrument be provided on board for each point, or may one instrument in conjunction with a multi-way switch be used ?

6. This should be carefully measured, as an error in the lengths will affect the readings.

7. Give lengths to withstand excessive heat and weather conditions separately, as insulation of cable will be difficult.

8. State which system of automatic control is preferred. See question 9.

9. For electricity, state system, voltage, and frequency ; for water and compressed air, state pressure in inches w.g. One of these mediums may be employed, control being effected by the thermometer, to open or close the valve controlling the heating medium used (viz., steam, hot air, oil or gas, fuel to burner, etc.).

10. Should show position of proposed control board, all points whose temperature is to be controlled and length of cables as they will be run.

## INSTALLATION, VENTILATING

1. Give an accurate description of the work carried on in each room.
2. State number of employees working in each room.
3. Is the incoming air to be cleaned ?
4. Must the air be maintained at a certain humidity ?
5. Is the air to be dried ? If so, state percentage of humidity which may be left in air.
6. Is air to be heated ?
7. Is air to be cooled ?
8. How is the fan to be driven ?
9. Enclose dimensioned plans and elevations of the building to be ventilated.
10. Is the air to be deodorized ?

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See B.S.S., No. 59.

1. Chemical works, explosive factories, textile mills, warehouses, halls, etc., and describe as clearly as possible work being done in each room.

3–9. The condition of the incoming air should be stated. This should include percentage of humidity, temperature in ° F. (maximum . .minimum average annual . for both) amount of dust in air, grains per cub. ft.

3. Enclose completed data sheet for filter or dust removal plant.

6. Enclose completed data sheet for heating installation.

7. Enclose completed data sheet for cooler.

8. From existing transmission, if so, state speed ; by electric motor, state system, voltage, and frequency of supply.

9. Indicate, on drawings, proposed air inlet, position of transmission or proposed position for motor, point of electricity supply.

10. If so, enclose data sheet for ozone deodorizer.

# INSTRUMENT, MEASURING, ELECTRICAL

1. What form of instrument is required ?
2. What type of movement is preferred ?
3. What is it to record ?
4. Give the maximum, minimum, and average value of the record required.
5. State the system, voltage, and frequency of the circuit to which it will be connected.
6. If the system is three-phase, is the neutral point available ?
7. What speed of recording chart is required ?
8. Is the paper to be rolled up in the instrument or come out through slot ?
9. Is the instrument to be connected to an existing instrument transformer ? If so, give full particulars of the transformer.
10. What class of finish is preferred ?
11. Give particulars of scale desired.

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See B.S.S., Nos. 89, 90.

1. Fixed or portable, indicating or recording, single or double face, for switchboard mounting, wall or pedestal, controller, flush or projecting pattern, with front or back connections, round, sector, or edgewise pattern, with or without illuminated scale, size of dial (i.e. diameter in inches). In the case of a synchroscope, state whether it is to have synchronizing lamps on top of the instrument.

2. Moving coil, moving iron, induction, etc.

3. Amperes, volts, watts, temperatures, leakage indicator, speed synchronoscope, frequency meter, power-factor meter, horse-power meter.

4. In the case of a leakage indicator, watt meter and power factor indicator, in addition to stating the watts and power factor, etc., to be recorded it is also necessary to state the maximum current to be carried.

6. System should state whether D.C., two- or three-wire ; is any one conductor earthed ? Single, two-phase, three- or four-wire ; three-phase, three- or four-wire.

7. 1, 2, 3, 4, or 6 in. per hour. Disc or drum type, state which.

9. The type of instrument transformer, maker, number of instruments already connected to the transformer, with their type and their combined volt-ampere capacity ; the ratio of transformation and the rated volt-ampere capacity of the transformer should be given.

10. All nickel finish, all black enamelled, black enamelled with nickel facings, etc.

11. State whether with central zero or not and length of scale desired. The latter is usually fixed by diameter of dial chosen (see question 1), but in some instances a scale of ca. 300° can be obtained. If this is desired, state fact.

12. In polyphase circuits, is the load balanced or unbalanced ?

13. Is the instrument to be used for testing purposes ?

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Is a double reading scale desired—such, for instance, as amperes and horse-power ? If it is to read more than one range of values (this can be arranged with some types of voltmeters, etc.), state number of ranges required and maximum value of each range to be recorded.

12. Need only be answered in case of wattmeters and power-factor indicators.

13. In this case, usually, a higher degree of accuracy will be required than is normally the case. State accuracy required if not left to maker. If a combined testing set containing two or more instruments is required, state this fact and give necessary particulars for each instrument.

## INSULATOR, ELECTRIC

1. State what type of insulator is required.
2. Of what material is the insulator to be made ?
3. What is the normal working voltage of the apparatus on which the insulator will be used ?
4. What is the system of supply ?
5. What size of conductor is to be carried by the insulator ?
6. In the case of a transmission line, state distance between masts.
7. For what purpose is the insulator required ?
8. Enclose fully-dimensioned sketch of the insulator if its form is specified.
9. Give full particulars of all tests to which the insulator will be subjected.

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See B.S.S., No. 137.

1. Pin, petticoat, or suspension. Choice is largely fixed by the voltage.
2. Porcelain or glass.
4. Single- two-, or three-phase, with or without earthed neutral.
5. State standard size or overall diameter in inches, and say whether of copper or aluminium.
6. In yards.
7. Is the insulator for—
(*a*) Transmission line mast.
(*b*) Terminal insulator leading to station or transformer.
(*c*) Wall insulator.
(*d*) Transformer or switch insulator.
(*e*) Telephone line.
(*f*) Telegraph line.
8. Need not be included if choice is left to maker.

## INSULATOR, MOULDED

1. State the material from which the insulator is to be made.
2. For what purpose will the insulator be used ?
3. What is the greatest potential gradient through the insulator in volts per mm. ?
4. State the maximum temperature under which the insulator will be used, ° F.
5. Has the insulator to resist any chemical action ?
6. Has the insulator to be fire resisting ?
7. Are there any special mechanical properties required ?
8. If metal parts are to be embedded in the material, of what metal are they to be made ?
9. Is the metal part to be galvanized, tinned or nickelled ?
10. Is the metal part to be matt finished or polished ?
11. Are the metal parts to be fixed to insulator or sent separately ?
12. Send fully-dimensioned sketch of the insulator and metal parts to be made.

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See B.S.S., No. 157.

1. Stabilit, tenacit, vulcanbest, bakelite, etc.

3. This may also be stated as the maximum potential difference across the thinnest portion of the insulator.

4. If the insulator is to be subjected to considerable heat for a long time this should be stated, and the average temperature and the length of time for which the insulator will be subjected to it, given.

5. If the insulator is to be non-hygroscopic, this must be stated. If it is to be used in chemical fumes or on apparatus coming in contact with chemicals, the nature of the fumes or chemicals should be stated.

7. Is the insulator to be tough or hard, to resist shock or vibration, liable to have to carry stress at any particular point, or to undergo certain mechanical tests ? Give particulars as fully as possible.

8. Copper, brass, aluminium, iron, steel, etc.

12. The sketch should show the limits within which it is essential to hold to the dimensions given. Moulded insulators cannot be made more exact than ca. + $\frac{1}{20}$ in.

## LAGGING, INSULATION

1. Submit a dimensioned sketch of the apparatus to be covered.
2. For what class of work is the lagging required ?
3. State temperature of the fluid in the vessel to be covered, in ° F.
4. What class of lagging is preferred ?
5. Will lagging be out-of-doors and subject to atmospheric conditions ?
6. Will lagging be subject to any vibration ?

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1. This should give outside dimensions of room, boiler, piping, etc., show and dimension all doors, manholes, taps, cocks, flanges, etc.
2. In connection with cold storage plant, steam plant, heating installations, etc.
3. In the case of boilers, etc., the steam pressure in lb. per sq. in. abs.. may be given ; for rooms, the temperature to be maintained in tho rooms ; for piping, the actual steam temperature should be given.
4. Cork, sawdust, bricks, slagwool, asbestos, 85 per cent magnesia, etc. The choice of this should generally be left to tenderer.

## LIFT, PASSENGER OR GOODS

1. State whether the lift is required for passenger or goods service.
2. State the lifting capacity required.
3. Give speed of travel desired in feet per minute.
4. Is speed regulation desired ?
5. What is the total travel of the lift in feet ?
6. State number of floors.
7. What is the distance between each floor in feet ?
8. State size and construction of hatchway required.
9. State nature of control desired.
10. How is the lift to be driven ?
11. Is overhead drive, basement drive, or drive from a room desired ?
12. Is a brake magnet to be provided ? If so, give particulars of type required.

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1. If a passenger lift is required, some idea of the quality of finish desired or a description of the building and its inner decoration should be given. If a goods lift is required, state whether to be erected indoors or outdoors. State also whether electric light is to be supplied in the car or cage.

2. Total number of passengers or weight of goods in lb.

3. If a non-stop to certain floors is required, this should be stated. If a two-speed lift is required, both speeds should be given.

4. This is employed for slowing down before a stop, and is usually only provided where the speed of the lift is over ca. 120 ft. per minute.

8. If the lift is to work in a built-up hatchway, brick shaft, stair-well, or in a room with trimmed floors, this fact should be stated. If openings are required on more than one side of the car or doors are to be fitted to the car, the sides of the car on which the openings are required and the openings to which doors are to be fitted, should be given. Is the enclosure to the shaft to be included in the price ?

9. State whether hand control, push button, or rope control is desired.

10. By hydraulic power, electric motor, pneumatic from existing shafting, steam-engine, etc. In the case of hydraulic power, state the water pressure in lb. per sq. in. abs., at the basement floor-level. If the hydraulic system is to be used in connection with a pump through a pressure tank, either in the basement or on the roof, the nature of the drive required for the pump should be stated. If electric drive is desired, state system, frequency, and voltage available. If by belt drive, give position of shaft relative to the lift, size of existing pulley in inches and speed of shaft in r.p.m.

11. The amount of headroom for the gear is very important, and this should be accurately shown on the sketch, as this will fix whether an overhead drive is possible.

12. State whether shunt or series type is to be used, the pull in lb. and the stroke in inches required. A series-wound brake magnet can only be used if

13. Are there any special regulations to be taken into account ?
14. Enclose a dimensioned sketch showing proposed layout of lift.

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the main current through the motor with fully loaded lift travelling down or empty lift travelling up exceeds ca. 10 per cent normal full-load current.

13. Such as limitations to the starting current taken by the motor, very silent running, police, or insurance regulations.

## LINE, TROLLEY

1. Is the trolley line on surface or underground ?
2. In latter case, enclose dimensioned sketch showing section of mine road and position of rails in the road.
3. What is the allowable height of the trolley wire from rail head in feet ? Maximum .. . ... Minimum........ ........ . .
4. What is the voltage of supply to trolley wire ?
5. Is one pole earthed ?
6. If ornamental poles are to be used, enclose dimensioned drawing of pole showing type preferred.
7. What type of current collector will be used ?
8. Are special precautions to be taken to prevent accidental contact with live trolley ?
9. State the load on the line in amps. Maximum. . Average. . ..
10. Enclose dimensioned map showing all branches, cross-overs, etc.
11. Is track single or double ?

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See B.S.S., Nos. 8, 23, 125.

Only poles and overhead equipment included on this data sheet.

2. It will be assumed that the section of the road remains the same throughout its length. Should there be any serious deviations from the average, these should be specified.

3. These dimensions will be fixed by section of road, bridges, or other similar obstructions.

7. Roller, drum, or bow.

8. If laid down by regulations, these should be specified.

9. When this cannot be done, answers should be given to questions 2–7 under light railway locomotive. Specify size of trolley wire, S.W.G., state section, grooved or figure 8, and give specification of material.

10. The dimensioned map should show the total length of trolley required with all sidings, cross-overs, branches, etc. It should also show the proposed feeding points of the electric supply, all gradients including length and amount of gradient as a percentage, all curves and their radius in feet.

## LOCOMOTIVE, LIGHT RAILWAY

1. What type of locomotive is required ?
2. State maximum load to be hauled by one locomotive in tons.
3. State maximum load to be hauled by one locomotive against an incline, in tons. Also state incline.
4. Give maximum net tonnage to be conveyed per day and number of hours worked.
5. State average speed required on the level in miles per hour.
6. State weight of an empty wagon in tons.
7. Give particulars of the material to be carried and specify net load per wagon in tons.
8. What will be the principal duty of the locomotive ?
9. Give length in yards and gradient in percentage of all inclines.
10. What is the radius of the smallest curve in feet ?
11. Are there any curves on an incline ? If so, give particulars.
12. What is the road gauge in feet clear between rails ?
13. Give particulars of the rails used.
14. Give particulars of the fishplates used.

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See B.S.S., No. 24.

Unless specially requested, neither overhead trolley wire nor accumulator nor air-charging stations will be quoted for. Questions 14 and 24–30 need only be answered when electric traction is required.

1. Steam-engine, oil engine, compressed air motor, fireless type, electric trolley locomotive, electric accumulator locomotive, live rail locomotive.
2. This includes weight of wagons and weight of load.
7. That is, whether coal, coke, ore, timber, sugar cane, etc.
8. Mainly for shunting work, or is it required mainly for long distance runs.
9. If a load is to be started against an incline, give particulars of load.
11. Give length of incline in yards, amount of incline in percentage, radius of curve in feet, and whether curve is at beginning or end of incline.
13. This should include weight of rails in lb. per yard, length of each rail in yards, section of rails used, and condition of rail if existing (i.e. worn or new).
14. This should include the sectional area of fishplate in sq. in., and number and size of the bolts used.

15. State distance from centre to centre of sleeper in feet.
16. What is the maximum load permissible on one axle in tons ?
17. Are there any restrictions as to the dimensions of the locomotive ?
18. Give particulars of the buffers and couplings on the wagons to be drawn.
19. Give particulars of the fuel available.
20. Is a plentiful supply of good water available ? Give particulars.
21. State maximum distance between fuel and watering stations in miles.
22. Give maximum tonnage that can be dealt with at port of discharge per hour.
23. Give a profile and contour map of the proposed track.
24. Where will the locomotive be used ?
25. In the case of electric traction, state the system, voltage, and frequency of the supply available.
26. Show position of the power station or point of supply on map asked for in question 23.
27. If the supply is from a private central station, give full particulars of the station.

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17. If there are, give maximum allowable length, breadth, height, and weight.

18. This should include a sketch of the wagon end, showing particulars of buffers and couplings, and give the height of the buffer centre above the head of the rail in feet.

19. State whether coal, coke, wood, oil, etc., and give average calorific value. In case of compressed air motor, state average air pressure in lb. per sq. in. abs., if a suitable supply is available. If not, firm tendering will choose pressure most suitable for the locomotive in question.

20. Say whether clean or muddy, hard or soft.

21. It is assumed that fuel and watering stations are together. If not, give maximum distance between two watering stations, as well as maximum distance between two fuel stations.

23. This should show proposed route and give lengths in yards or miles, radius of curves in feet and gradient in per cent. Position of watering and fuel stations should also be shown.

24. In open, under cover, in mines, near sea, in tropics.

27. This should include number and size of generating units, overload

28. If continuous current is available, can one pole be earthed ?
29. State the maximum and minimum allowable heights for the trolley wire, in feet.
30. What type of current collector is preferred ?
31. State maximum length of single run in yards.

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capacity of each, and average daily load curve showing present load conditions.

30. State whether roller, drum, or bow collector is preferred. If to be used on a rail collecting system, state whether third or fourth rail system is employed.

31. This is of importance in the case of battery locomotives, so as to arrange for suitable charging of the batteries. If a long run with inclines and cruves, position of run should be indicated on map.

## MACHINE, FOUNDRY MOULDING

1. State output required from the machine per hour.
2. State total weekly output required from one machine.
3. Enclose dimensioned sketch of the casting to be made.
4. Give particulars of the material to be cast.
5. Is machine to be adjustable ?
6. What type of pattern plate is required ?
7. State type of machine desired.

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Generally only used for mass production.

1–2. Number of castings.
3. This should be fully detailed. If possible, also send sample casting.
4. Brass, white metal, cast iron, etc.
5. To take varying widths of pattern plate.
6. Plain or draw pattern.
7. Hand or hydraulic ramming or jolting machine.

## MAGNET, BRAKE

1. What type of brake magnet is required ?
2. State pull required in pounds.
3. State stroke required in inches.
4. State the b.h.p. and the rating of the series motor with which the magnet is to be used.
5. What is the maximum current to be carried, in amps.?
6. What is the minimum lifting current passing through the magnet in amps.?
7. What is the minimum current passing through the magnet that will hold the load in amps.?
8. State voltage of supply.
9. State system and frequency in the case of A.C. magnets.
10. Give the application of the motor in connection with which the magnet will be used.
11. State any special requirements.

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This data sheet is also applicable to brake motors.

1. Shunt or series on continuous current system, magnet or motor on A.C. systems. Also state whether ventilated or totally enclosed pattern is required.

2. In addition, state whether a push or a pull is required. The weight of the armature should always be balanced, otherwise the effective pull of the magnet will be reduced by this amount. The firm offering the magnet should always state the weight of the armature.

4. In cases where the lifting capacity of the magnet is large compared with the motor current available, such for instance, as sometimes occurs when the brake drum is mounted on a countershaft instead of direct on the motor shaft, a special design of magnet may be necessary.

4–7. Refer to series-wound continuous current magnets. If the motor is lifting practically no load, as when hoisting empty hook, and has very efficient gearing, sufficient current may not pass through magnet to lift the armature, hence the importance of question 6.

5. This should be the current passed on the first stop of controller.

6. May be expressed as a percentage of the full-load current of the motor.

10. State whether for hoisting, travelling motions on cranes, opening or closing valves, etc., and rating of motor, i.e. whether continuous or intermittent and, in latter case, whether 30, 40, 60 or 90 minute rating. Also state whether rheostatic breaking is employed.

11. Such as very silent operation.

## MAGNET, LIFTING, ELECTRIC

1. State lifting capacity required in pounds.
2. Give particulars of the material to be handled.
3. Give dimensions of largest piece to be lifted.
4. Is material to be handled hot or cold ?
5. What type of magnet is preferred ?
6. Give particulars of the situation in which the magnet will be used.
7. State system, voltage, and frequency of the supply available.
8. If the magnet is to be carried by an existing crane, state maximum weight which crane can carry.

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2. This should state whether castings, balls, rails, angle or channel iron, billets, blooms, pig iron, crop ends, general scrap iron, etc., is to be handled.
3. Round or rectangular.
4. Indoors or outdoors ; near sea or in corrosive fumes ; whether magnet is to lift from a stack or a rough heap.
8. This will limit the size of magnet which can be used.

## MAST, TRANSMISSION LINE

1. What type of mast is required ?
2. Of what material shall the mast be constructed ?
3. Give particulars of the conductors to be carried.
4. Give spacing of conductors in feet.
5. State space between masts in yards.
6. Give particulars of the cross-arms to be used.
7. What type of insulator is to be used ?
8. On what basis are the masts to be calculated ?
9. In the case of angle masts, give a detailed dimensioned sketch showing the angles between the various lines, length of space in yards on either side of the angle mast, and particulars of conductors on the branch line.
10. State minimum distance in feet allowable between lowest point of conductor and ground.

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See B.S.S., No. 139.

1. State whether ordinary intermediate masts, angle-masts, end-masts, special intermediate masts for taking strain if line breaks, special masts for road, rail, or telegraph crossings or masts for branching-off are required. Also state where choice is open, whether single, A, H, or four-member masts are preferred.

2. Wood, reinforced concrete, solid-drawn tube, semi-flexible pole, square or tripod latticed structural steel towers.

3. This should include—

(*a*) Number to be carried by the mast.
(*b*) Material of conductor, i.e. copper, aluminium, bronze, etc.
(*c*) Breaking strain.
(*d*) Size of conductor, i.e. size of strand, number of strand, and overall diameter.

4. Give sketch showing arrangement of the conductors (including earth wire) on mast.

6. This should include general construction, overall length in ft. and weight in lb. These particulars need only be given if the cross-arms are not to be provided by the firm tendering for the masts.

7. State whether fixed or suspension type insulator, and weight in lb. of complete insulator fixed (i.e. including bolt, etc.).

8. The stress on the masts will be due to—

(*a*) Its own weight.
(*b*) Weight of cross-arms and insulators.
(*c*) Weight of the conductors.
(*d*) Pull of the conductors.
(*e*) Wind pressure.
(*f*) Ice load.

It is first necessary to specify the manner in which wind pressure and ice

11. State nature of ground over which line is to be carried.
12. Give dimensioned profile and contour maps showing proposed run of line.

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load are to be calculated, i.e. what extent of the exposed surfaces may be assumed under wind pressure; what the amount of the ice or snow load on the conductors and insulators may be assumed to be; and whether both these loads may be assumed as acting at once, or what two conditions of wind pressure and ice load may be taken as occurring simultaneously. The following notes may act as a guide—

(*a*) Ordinary intermediate masts. Should be calculated for: (1) Wind pressure at right angles to line. The wind pressure should be that on the conductors of half of each of the neighbouring spans together with that on the mast, cross-arms, and insulators and unbalance due to one broken conductor. (2) Wind pressure in the direction of the line based on the pressure on mast, cross-arms, and insulators.

(*b*) Special intermediate masts. (1) Two-thirds of the maximum one-sided pull due to all conductors being broken on the other side and wind pressure on mast, arms, and insulators at right angles to the line, both acting simultaneously.

(*c*) Angle masts. (1) For the resultant of the maximum pulls (conductor) and a wind pressure on mast, arms, and insulators acting in the direction of the resultant, both acting simultaneously.

(*d*) End-masts. (1) For the maximum one-sided pull and wind pressure on mast, arms, and insulators at right angles to the line, both acting simultaneously.

(*e*) Branching-off masts. (1) Dealt with in same as for angle-masts.

(*f*) Special cross-over masts. To be calculated as laid down by railway, road, or postal authorities, etc.

11. Whether rocky, swampy, sandy, etc.

## MATERIALS, RAW

1. State name of material required.
2. What is its chemical composition ?
3. In what form is the material to be supplied ?
4. State in what finish the material is to be supplied.
5. Give particulars of any treatment material is to undergo.
6. Give full particulars of any physical tests that the material is to satisfy.
7. State section required.
8. State length of piece required.
9. If material is to be supplied semi-finished, give full particulars of finished dimensions.

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1. Iron, steel, alloy steel, brass, bronze, copper, aluminium, etc., vulcanite, micanite, bakelite, etc.

2. This should be given fully when it is of importance.

3. Plate, sheet, strip, tape, bar, rod, wire, pipe, tube, etc.

4. Plain or bare, galvanized, tinned, lead coated, nickel, copper, or silver plated, enamelled, etc. Where necessary, state composition of coating and weight per sq. in. of surface.

5. Where there is more than one process of manufacture (excluding variation in composition), particulars of the process preferred should be given. Thus, state whether, drawn or extruded, hot or cold rolled, soft or hard temper (state temper required).

6. Ex. Breaking strain and percentage of elongation, Brinnell hardness number, dielectric strength, etc. If to satisfy any standard specification, quote specification number.

7. If special, submit sketch. For plate, sheet, strip, tape, bar, state width and thickness ; rod, wire—if round, state diameter, if of any other section, enclose a dimensioned sketch.

Pipe, tube—solid or flexible ; if latter, what type is preferred. Inside diameter and gauge in S.W.G. (specify any other gauge if used). Or inside and outside diameters. Whether open joint, brazed, welded or solid drawn. Type of joint required, flange, butt, spigot, and socket, screwed (whether inside or outside) and what thread is to be used (Whitworth, British Standard, etc.). Trolley wire—S.W.G. or B. and S., gauge number, groove or figure 8 section. Cable—number of strands and gauge of single strand, particulars of core if special.

8. This should be stated if stock sizes are not suitable. In the case of wire, tape, tubes, can it be supplied in coils, or in random lengths, or must a specified straight length be adhered to ?

9. In the case of wire or tube coils, state length. State free length unloaded. State length loaded, if important.

Diameter or width. Inside or outside of the coil, whichever is the most important.

Number of turns or laps.

Enclose sketch showing how ends are to be dealt with.

## 10. For what purpose is the material required ?
## 11. Has material to have special resisting qualities ?

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Type of spring required, conical, helical, volute, etc.

In case of boiler tubes, state the nature of the swelling required.

In case of superheater tubes, submit sketch showing how they are to be bent.

In case of any tube, etc., which has to be supplied bent, submit a dimensioned sketch.

10. Boiler tubes, superheater tubes, fuse wire, nail wire, rivet wire.

When tubes, etc., are to be under pressure, state liquid or gas to be carried and pressure in lb. per sq. in. abs. Also state whether tube, etc., is to withstand internal or external pressure.

11. If material to be heat resisting, state maximum temperature in ° F. it is to withstand.

Rustless; oil, acid. or alkali resisting ; state name of liquid, its temperature in ° F., and its concentration.

The following British Standard Specifications should be consulted when applicable—

No.
6. Rolled sections for structural purposes.
7. Copper conductors.
9. Bull head railway rails.
11. Flat bottom railway rails.
12. Portland cement.
13. Steel for shipbuilding.
14. ,, ,, marine boilers.
15. ,, ,, bridges.
29. Steel forgings for marine purposes.
30. Steel castings for marine purposes.
32. Steel bars.
35. Copper alloy bars.
43. Boiler tubes.
48. Wrought iron of smithing quality.
51. ,, ,, for use in railway rolling stock.
61. Copper tubes.
76. Tar and pitch for road purposes.
111. Wrought steel for aircraft.
112. Cold worked steel for aircraft.
113. Sheet steel for aircraft.
114. Valve and valve spring steel for aircraft.
115. Metallic resistance materials for electrical purposes.
121. Motor and aviation spirit.
125. Hard drawn copper solid and stranded conductors.
128. Bare annealed copper wire.
135. Benzol for motor fuel.
144. Creosote.
146. Portland blast furnace cement.
148. Insulating oils.
156. Enamelled plain copper wire.
163. Galvanized steel wire.
187. Sand lime bricks.
198. Electrolytic copper wire bars, cakes, slabs, and billets.
199. ,, ,, ingots and ingot bars.
200. Tough copper cakes and billets for rolling.
201. Fine copper cakes for rolling.

No.
202. Electrolytic cathode copper.
203. " Best select " copper.
206. Silver solder.
207. Special brass ingots for castings.
208. Special brass castings.
209. Petroleum and shale oils.
210. Pure mineral lubricating oils.
215. Hard-drawn aluminium and steel-cored aluminium conductors.
216. Vulcanized fibre.
218. Brass bars and sections.
219. Soft solders.
224. Steel for die blocks.
231. Pressboard for electrical purposes.
234. Ebonite.
239. White lead.
241. ,, ,, oil paste.
242. Refined linseed oil.
243. Raw linseed oil.
244. Turpentine.
245. White spirit.
249. Brass bars for high-speed turning.
250. ,, ,, and sections (high tensile).
254. Zinc oxide.

## METER, COAL

1. Give amount of coal burnt per hour in tons. Average . .. .. . . Maximum................
2. With what make of grate is the meter to be employed ?
3. Give particulars of the boiler with which it will be used.
4. State type of meter required.
5. State speed of shaft for driving recorder.
6. Where will meter be fixed ?

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This data sheet may also be used for coal flow indicator, but in this case no integrating arrangement is provided.

2. Chain grate, etc.
3. Name evaporative capacity in lb. of water from and at 212° F., boiler pressure, and width of fire door in ft.
4. Integrating only, or integrating and indicating.
5. Usually worm shaft of the stoker may be used.
6. On boiler front, or elsewhere.

## METER, ELECTRICITY

1. State what class of meter is required.
2. What system of meter is preferred ?
3. What type of meter is required ?
4. Is the meter to be fitted with a current-limiting device ?
5. If so, state value of the current at which control is required.
6. Is a prepayment meter required ?
7. Is the meter to indicate the maximum demand made by the consumer ?
8. Is a double tariff meter required ?
9. Is the meter to have an integrating system for each tariff ?
10. How is the meter to be switched over from one tariff to the other ?
11. Is the meter only required to record after a certain definite rate of power demand has been passed ?
12. If so, state point at which meter has to commence recording, in kW.
13. State system, voltage, and frequency of supply.
14. State maximum current to be carried by meter.
15. Is a two-, three- or four-wire meter desired ?
16. Is the meter to be portable, mounted on a switchboard, or in private house ?

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See B.S.S., No. 37.

1. Ampere-hour meter, watt-hour meter.
2. Moving coil, motor, oscillating, pendulum or induction. Choice is limited by system of supply.
3. Total integrating or partial integrating over certain periods.
6. In which case, state price per unit and coin to be used.
7. State also whether to be quarter, half, or one hour resetting period.
10. By a clock in meter, or by a special line from the central station.
14. This is the current in circuit whose demand is to be recorded. This value of the current may not necessarily pass through the meter if transformers are necessary. If a meter is to be run from an existing instrument transformer, give full particulars of this transformer as asked for on corresponding data sheet, but data to refer only to the instruments already connected.
16. State also whether meter is to have front or back terminals.

17. State whether the load is balanced or unbalanced.
18. Is a multirange meter desired ?
19. State whether meter clock is to be electrically or hand wound.
20. Give particulars of any special finish required.

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18. If so, state number of ranges required, and whether for voltage or current with maximum value of each range.

20. Black enamel, nickel, etc., aluminium, sheet iron or glass cover, etc.

## METER, GAS

1. State quantity of gas to be measured in lb. per hour. Maximum. . . . Minimum . . . . .

   Average. .... . ... ..
2. Give particulars of the gas to be measured.
3. Does it contain dust ? If so, state amount of dust present in grains per cubic foot.
4. Is the gas wet ? If so, state percentage of wetness.
5. What is the temperature of the gas at the meter in ° F. ?
6. Does this temperature vary ? If so, give range in ° F.
7. What is the pressure of the gas at the meter in lb. per sq. in. abs. ?
8. Does this pressure vary ? If so, give range in lb. per sq. in.
9. Is gas flow steady or pulsating ?
10. Give diameter of gas main where meter will be fixed in inches.
11. What type of flange is required ?
12. What type of instrument is required ?
13. Give dimensioned sketch showing proposed position of instrument and main.

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1. Measured at the temperature given in question 5, and pressure in question 7.

2. Air, carbon dioxide, oxygen, chlorine, etc., weight in lb. per cub. ft ; percentage of humidity.

12. State whether an indicating, recording, or integrating instrument, or a combination of these is desired. Are the charts of recording instruments to be daily or weekly ? In what unit is the meter to record. In the case of a house meter, is a wet or dry type preferred, or is it to have a prepayment attachment ?

## METER, LIQUID

1. State quantity of liquid to be measured in gal. per hour. Maximum . Minimum. . .
2. What is the quality of the liquid ?
3. State temperature of the liquid at entrance to meter in ° F.
4. Is the temperature of the liquid variable ? If so, give range in ° F.
5. What is the static pressure in the main in lb. per sq. in. ?
6. What will be the static pressure at the floor level of the recorder house ?
7. Give diameter of the main in feet.
8. What type of flange is required for the meter tube ?
9. What type of recording instrument is desired ?
10. Give dimensioned sketch showing proposed position of instrument and main.

---

2. State whether water, acid, oil, spirits, etc., and whether gritty, acid, alkaline, etc.

8. Is meter tube to be provided with flanges, spigots, or sockets at both ends. or spigots down stream and sockets up stream ?

9. Is the meter to be recording only and, if so, are daily or weekly charts desired ? Or is it to be a combined recording and integrating meter.

See also data sheet for water recorder.

## METER, STEAM

1. State quantity of steam to be measured in lb. per hour. Maximum . . Minimum .
2. Give temperature of steam at meter in ° F.
3. If steam is wet, state percentage of wetness. Maximum . ... Minimum . . .. Average .
4. What is the steam pressure in lb. per sq. in. abs. ?
5. Is the steam flow steady or pulsating ?
6. Give diameter of steam main in inches.
7. What type of flange is required ?
8. What type of instrument is desired ?
9. Give dimensioned sketch showing proposed position of the instrument and steam main.

---

4. If the steam pressure is variable, give maximum and minimum limits.

8. State whether an indicating, recording, or integrating instrument, or a combination of these is required. Are the charts of recording instruments to be daily or weekly ? In what unit is the meter to record ?

## MILL, GRINDING

1. Give particulars of the material to be ground.
2. State output required in tons per hour.
3. State size of material as fed into the grinder.
4. What degree of fineness is required in final grinding ?
5. Is wet or dry grinding preferred ?
6. What type of grinder is preferred ?
7. How is grinder to be driven ?
8. Is mixing of other materials to take place in this grinder ?
9. Are there any special conditions to be observed ?
10. Enclose dimensioned sketch, showing proposed layout.

---

1. Name, cement, basic slag, lime, flour, cotton seed, etc. Hardness, for minerals only. Wet or dry, state percentage of moisture. When possible, supply a suitable sample of the material for testing purposes.

3. State what size of mesh it will pass through. The mesh should be clearly specified as so many holes per lineal inch, per sq. in., or per sq. cm.

4. State what percentage of the final grinding must pass through a mesh of given size or a given sieve number.

6. Edge-runner grinding mills, rollers, ball mill, tube mill, etc. This is fixed to some extent by the material to be ground and fineness required. Also state whether fixed or portable pattern. The latter are practically only met with for edge-runner grinders for mortar mixing.

7. From transmission, give speed in r.p.m. and size of available pulley in inches ; or electric motor, state speed in r.p.m.

It is assumed that neither motor nor other form of drive is to be included. If these are also to be offered, fill in respective data sheets.

9. Such, for instance, as that material to be ground may not come into contact with steel.

## MILL, MIXING

1. Give full particulars of each material to be mixed.
2. State percentage of each material to be mixed.
3. Is wet or dry mixing to be employed ?
4. State quantity of mixed material to be delivered per hour in tons. Maximum . ... Average . ...
5. Is weighing apparatus to be attached ?
6. Is material to be ground as well as mixed ?
7. What type of plant is preferred ?
8. Where will mill be used ?
9. How is mixer to be driven ?
10. Must the materials be kept at a definite temperature during mixing ? State temperature in ° F.
11. How is this temperature to be maintained ?
12. Give particulars of any steam supply available.
13. Give particulars of water supply available.
14. Enclose dimensioned sketch showing proposed layout.

---

1. Name, gritty or soft, percentage of moisture contained, fineness expressed as the percentage left on a sieve of specified mesh. Has it any corrosive action ?

3. If wet mixing is to be employed, state approximate consistency required of the mixed material as it leaves the machine.

4. State duration of maximum demand.

5. Or measuring apparatus.

6. If so, see data sheet on grinder.

7. Centrifugal, riddling, runner mill.

8. In chemical works, foundry, oil cake mill.

9. By belt, chain, or direct-coupled. If from transmission, state speed ; if by steam-engine, state steam pressure in lb. per sq. in. abs. and temperature in ° F. If by electric motor, enclose data sheet.

11. By flame, by bath (oil or water) ; by water or steam jacket.

12. Source, quantity in lb. per hour, temperature in ° F., pressure in lb. per sq. in.

13. Source, quantity in gallons per hour, pressure in inches w.g., temperature in ° F.

14. This should show how the material is delivered to the mill, and how it will be taken away from the mill.

## MILL, ROLLING, ELECTRICALLY DRIVEN

1. State type of mill to be used.
2. Give the number of housings in the train.
3. State the diameter and length in feet of the rolls in each housing.
4. Give the speed of the rolls in r.p.m. Maximum ..... .. .. .. Minimum Average.
5. Does the train run continuously in one direction, or will it be occasionally required to run reversed ?
6. Or is a reversing mill to be used ?
7. Is the train already working ? If so, give full particulars of how it is driven.
8. Are the rolls fitted with a fly-wheel ? If so, give its weight in tons and its fly-wheel effect in feet-pounds.
9. What is the material to be rolled ?
10. State the output required from the mill in tons—
    (*a*) Per shift.
    (*b*) Normal hourly output.
    (*c*) Maximum hourly output, and
    (*d*) Average production per year.
11. What is the length of a shift in hours, and how many shifts are worked per day ?

---

Questions 5, 8, and 22 refer to non-reversing trains only.

1. State whether two-high, three-high, etc.

7. If train is already driven by a steam-engine, say, whether direct-coupled or through-gear, state gear ratio, type of engine used (i.e. compound, triple expansion, etc.), diameters of cylinders in inches, length of stroke in inches, average and maximum speed in rotations per minute, steam pressure in lb. per sq. in. abs., and temperature in ° F. at engine stop valve, vacuum in inches mercury at engine exhaust, maximum i.h.p. of engine and average steam consumption in lb. per hour. If possible, send a continuous indicator diagram, showing the steam consumption during rolling a certain weight of a certain section (specify weight and section).

9. Iron, steel, copper, brass, zinc, etc.

12. State the average number of rolling hours per year.
13. State the maximum weight of the single piece of raw material fed into the mill in tons.
14. State the maximum dimensions of the single piece of raw material fed into the mill in inches.
15. What percentage of the total output is to be hard rolled ?
16. Of what form is the finished material to be ?
17. Send a dimensioned sketch showing the cross-section of the finished material.
18. State the maximum lengths in feet required of all the finished material rolled in the mill.
19. Will the material be cut during rolling ? If so, after what pass, and in how many pieces ?
20. In how many passes will the material be rolled to obtain the finished section ?
21. How many housings in the train will be simultaneously rolling material ?
22. Is speed regulation required ? If so, between what limits ?
23. State system, voltage, and frequency of the supply available.
24. If the supply is from a private central station, give full particulars.
25. Is the motor to be direct coupled or work through gear ?

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13–14. These questions refer to the raw material, i.e. the billet before it enters the first pass.

16. State whether round, square, angle iron, channel iron, rail, wire, or plate.

17. This requires an accurately-drawn, fully-dimensioned sketch of the finished material as it leaves the last pass. If possible, similar sketches should be given for each pass to enable the amount of work to be done at each pass to be calculated.

24. The particulars given should include the number of units, size of each in kW. or kVA., overload capacity of each, how driven, and a specimen of the average daily load curve on the station.

26. Will more than one train be driven by the motor? If so, state whether together or alternately.
27. Enclose a dimensioned sketch showing proposed layout.

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26. If the trains are different, a second data sheet answering the relative questions set out above should be given for the second train.

27. This should show the proposed site for the motor and motor-generator set (if required), their position relative to the mill to be driven, and point of electricity supply. If the cables to the motor have to be taken across the feed rolls, full particulars of the feed rolls and their foundations should be included on the sketch.

# MOTOR, ELECTRIC

1. For what system of supply is the motor required ?
2. Give voltage and frequency of supply.
3. State output required from motor in b.h.p.
4. State speed of motor required in r.p.m.
5. Is speed regulation required ? If so, state extent.
6. Is the motor required for continuous or intermittent service ?
7. What type of motor is required ?
8. What form of motor is required ?

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See B.S.S., Nos. 168, 169, 173, 226.

1. D.C., single-, two-, or three-phase.

2. The voltage across the outers or between phases should be given. If the motor is to be used in conjunction with a star-delta starter, this fact should be mentioned. If voltage is variable, give range and state whether output in question 3 is required over whole range.

4. If in the case of a constant speed motor it is necessary that the speed given in answer to this question should be exactly obtained, this fact should be stated in the inquiry.

5. State how to be obtained ; by field or armature regulation, changing number of poles, etc. The extent of the speed regulation which is required above and below the normal full-load speed should be separately stated, as a percentage of normal full-load speed. Also state whether output given in question 3 is required at all speeds. If not, state outputs at various speeds.

6. In the case of an intermittently rated motor, state whether for 30, 40, 50, 60, or 90 minute service. If it is not possible to answer this question, full particulars of the machine to be driven, as asked for under question 11, should be given.

7. Under this question should be specified the nature of the field winding for D.C. motors, whether shunt, series or compound and, in the latter case, the nature of the compounding required, i.e. whether to maintain constant speed or to decrease the speed on load and the extent of the compounding required, given as the percentage alteration in full-load speed to be effected by the compounding. As a general rule, D.C. motors should not be used with a compound winding which reduces the normal field strength, and hence compound-wound constant speed motors are not usual. In the case of A.C. motors, state whether squirrel cage, slip ring, or commutator type rotors are required. If squirrel cage, state the method which will be employed to start the motor, i.e. by means of a switch only, resistance in the stator circuit, star-delta started, or by auto-transformer. If a slip-ring motor is desired, state whether the slip rings are required for starting only and must, therefore, be short-circuited on the motor attaining full speed, or whether motor is required for speed regulation purposes. If a synchronous motor, state how it is to be started ; self-starting, starting motor, etc. If motor is to be used for power-factor correction, enclose completed data sheet for synchronous condenser.

8. It should be stated whether the machine is to be provided with standard

9. What nature of enclosing is required ?
10. Is reversible operation required ?
11. State nature of the work to be done, or give particulars of the machine to be driven.
12. State overload capacity desired.
13. State maximum temperature of surrounding air in ° F.
14. Give particulars of any special tests to be given to motor.
15. Is special insulation necessary ? If so, give particulars of the situation in which the motor will be erected.
16. State the fly-wheel effect required in the rotor if this is important.
17. State starting torque required from motor.

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pulley, free shaft end, one bearing short shaft and half coupling, or no bearings or shaft. If pedestal bearings are required and the design of the motor allows for this, it should be stated whether the pedestal bearings are all to be on separate sole-plates ; or two on a common bedplate with the motor, or three, i.e. including an outboard bearing on a common bedplate with the motor. In the last case, the space to be left between middle bearing and outboard bearing for the pulley should be given. When the motor is not to be provided with a shaft, but is intended for erection direct on the machine shaft, it should be stated whether the motor rotor is to be in two halves or not. If a motor with a vertical shaft is required, it should be stated if the top motor bearing is to carry a weight in excess of the weight of the motor rotor. As a general rule, this should be avoided. If ball-bearings are required, specify this.

9. This should state whether the motor is desired open-protected ; semi-enclosed with gauze covers or louvres ; semi-enclosed ventilated (one shield with louvres, the other with pipe connection), totally enclosed water or air cooled ; totally enclosed explosion proof ; submersible, etc. Motors with slip-ring rotors can be obtained with outside enclosed slip rings and open motor. The slip rings may be enclosed with ordinary or explosion proof protection, as desired.

11. A full description of the work to be done, or the machine to be driven, should be given. This is very important when it is not possible to give the exact intermittent rating, asked for in question 6. Is the load constant, fluctuating, or impulsive ?

13. This may be given as the average of the hottest 8 hours of the year. Specify the allowable temperature rise if this is not left to the maker.

15. This may be protection against moisture, chemical fumes, or chemical dust, etc.

16. If the required moment of inertia is known this should be stated in ft.$^2$ tons. Otherwise, if the load is fluctuating give the permissible variation in speed in r.p.m. above and below the mean speed.

17. This may be given as so many times normal full-load torque or in

18. Is a suitable D.C. supply available for excitation purposes ? Give particulars.
19. What accessories are required ?

---

ft.-lb. State type of starter to be used, and if to be offered with the motor, enclose completed data sheet.

18. Only necessary for synchronous motors, state voltage. If no supply is available, is a direct-coupled exciter to be included ?

19. Starter, slide rails, pulley, foundation bolts, etc.

## MOTOR, GENERATOR

1. State continuous output required from generator in kW.
2. State percentage overload required, and its duration.
3. Give system, voltage, and frequency of supply required from generator.
4. State system, voltage, and frequency of supply to the motor.
5. State type of motor preferred.
6. State type of generator required.
7. How is the motor to be started ?
8. Is the motor also to be used for power-factor correction ?
9. State speed of set desired.
10. Is a L.T., D.C. supply available for excitation purposes ?
11. Is the set to run inverted ?
12. Is the generator to run in parallel with others ? Give particulars of other generators.
13. State temperature rise allowable in ° F.

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This data sheet may be used for A.C. to A.C., A.C. to D.C., D.C. to D.C., D.C. to A.C. sets, frequency chargers.

1. In the case of A.C. generators, state the power factor at which this is required.

3. D.C. or A.C., single-, two-, or three-phase, two-, three-, or four-wire.

3–4. If the voltage is variable, state range, plus or minus volts from normal.

5. Shunt or compound, squirrel cage, slip ring or synchronous. It will be assumed that the motor is for erection in a non-deleterious indoors atmosphere. If not, state type of special insulation required.

7. By hand or remote electrical control.

8. In this case, enclose complete data sheet for synchronous condenser.

9. Choice should be left the manufacturer unless there are special reasons for specifying the speed.

10. It is necessary for excitation of synchronous motors, give voltage. If none is available, is an exciter to be included.

11. In this case, answer questions 3 and 12 for both ways of running. The output from set need only be given one way, as this will fix the size of set. Give that output which is the more important of the two.

12. Type of generator, type or prime mover, output in kW., speed, etc.

14. With what apparatus will the generator be used ?
15. In case of synchronous motor sets, how is set to be started ?
16. State what accessories are to be included.

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14. Lighting or power load, in latter case, average size and type of motor, traction, welding apparatus, etc.
15. From A.C. or D.C. side.
16. Starter, shunt regulator, foundation bolts, etc.

## OVEN, BAKERY, ELECTRIC

1. State kind of bread or cake to be baked.
2. State weight of bread, etc., to be baked per day in pounds.
3. State number of working hours per day.
4. Is baking done during the whole of this time ?
5. How long does it take to bake each batch, in minutes ?
6. Give number and weight of loaves which are baked per square foot of shelf.
7. State weight of loaves per batch, in pounds.
8. Are removable heating elements required ?
9. State system, frequency and voltage of available supply.
10. Enclose dimensioned sketch showing space available for oven.

## PANEL, CONTROL

1. State what class of circuit panel is to control.
2. What type of panel is preferred ?
3. What pattern of panel is desired ?
4 State where panel will be erected.
5. Give particulars of supply on which panel will be used.
6. State current in the circuit to be controlled by the panel.
7. Is panel to be suitable for future extensions ?
8. State what type of apparatus is to be employed in the panel.
9. What type of fittings is required ?
10. State number of circuits to be controlled.
11. Give particulars of all interlocking arrangements requ`red.
12. Give particulars of any accessories wanted.
13. Enclose dimensioned sketch showing space available for panel.

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1. Motor, transformer, feeder, furnace, etc.
2. Ordinary or foolproof, open on marble slate, totally enclosed ironclad, totally enclosed sheet metal clad, ironclad gear on angle iron frame-work.
3. For wall mounting, as independent cabinet on floor or as pedestal.
4. Above ground or in mine, damp or dry situation, in dusty atmosphere, etc.
5. System, voltage, and frequency.
7. In which case it will be provided with suitable busbars, etc.
8. This covers instruments, switches, fuses, starters, controllers, speed regulators. In these cases enclose data sheets for each type of apparatus covering all relevant questions. If starter, controller, speed regulator, switch, etc., is not to be supplied by panel maker, enclose a fully-dimensioned sketch of the apparatus, so that necessary space may be provided.
9. Bushed glands, conduit fittings, cable glands, cable end boxes, etc.
10. Give answer to question 6 for each circuit.
11. Door with switch, switch with starter or controller, dead man's handle, etc.

## PILER, SACK

1. State quantity of material to be dealt with in lb. per hour. Average.......... Maximum. ...
2. State weight of each sack in pounds.
3. Give description of sack or package to be handled.
4. What is the height of pile required in feet ?
5. How is the piler to be driven ?

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5. The sack piler will usually be portable, in which case electric drive is the best. State system, voltage, and frequency of supply available.

## PILLAR, CONTROL

1. State what class of circuit the pillar is to control.
2. Give particulars of the supply on which the pillar will be used.
3. State current in the circuit to be controlled, in amps.
4. State type of apparatus to be employed in pillar.
5. What type of fitting is required ?
6. Give particulars of any interlocking arrangements required.
7. Enclose line diagram of connections of circuit to be controlled.

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See also data sheet for control panel.

1. Equalizer pillar, exciter pillar, regulating pillar, synchronizing pillar.
2. D.C. or A.C., single-, two-, or three-phase, three- or four-wire, voltage and frequency.
4. This covers instrument, switch, fuse, regulator, etc. Enclose data sheet covering the type required. If the switch, regulator, etc., are not to be supplied by pillar maker, enclose dimensioned sketch of apparatus to be used.
5. Conduit fittings, cable glands, cable end boxes.
7. This should show all the instruments, etc., which are to be included on the pillar.

## PILLAR, FEEDER

1. State for what purpose pillar is required.
2. Give particulars of the system on which it will be used.
3. State number of poles required.
4. Give number of ways per pole.
5. Give normal current to be carried by each way, in amps.
6. What type of fuse is to be employed ?
7. Are switches to be included ?
8. Is a main switch to be provided ?
9. Is this to be interlocked with pillar ?
10. Give particulars of any instrument to be included.
11. Are cable end boxes to be included ?

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1. For street lighting, power distribution, feeder control, etc.
2. System, D.C. single-, two-, or three-phase, two-, three-, or four-wire, voltage and frequency.
5. This is the amperage for each way, all of which are not necessarily the same.
6. Switch fuse, etc.
7. If switch fuses are not employed, is a switch to be provided for each way ; give particulars of type of switch preferred.
8. To control the whole pillar.
10. Meter, ammeter, voltmeter.
11. Give particulars of incoming and outgoing cables.

## PIPE, LINE

1. What type of pipe is preferred ?
2. State total length of pipe required in feet.
3. Give diameter of pipe required in feet.
4. State what internal pressure the pipe is to withstand in lb. per sq. in. abs.
5. For what fluid is the pipe to be used ?
6. State temperature of the fluid in ° F.
7. How is the pipe to be erected ?
8. Is the pipe to be galvanized or coated with asphalt compound or provided with non-conducting lagging ?
9. What type of joint is desired ?
10. If flanges are to be used, specify what type.
11. Are pressure-equalizing pipes required ?
12. How many expansion joints are required ?
13. How many fittings are required ? Give number of each type.

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See B.S.S., Nos. 10, 44, 78.

This data sheet covers water mains, gas or air mains, hydraulic mains, steam mains, oil pipe lines, hydro-electric pipe lines, etc. ; only those questions actually referring to the class of main under consideration need be answered.

1. State whether cast iron, copper, bronze, steel riveted, lap welded, solid drawn, or spiral riveted.

4. It is assumed that this will remain approximately constant throughout the length of the line ; should it vary, give maximum pressure occurring. In the case of hydro-electric lines it may vary very considerably and, in this case, therefore, the profile map asked for in question 15 is very important. In the case of a vacuum pressure main, state vacuum in inches of mercury or lb. per sq. in. abs.

5. State whether water (also state whether corrosive, gritty, etc.) brine, live steam, exhaust steam, paper pulp, air, producer gas, blast furnace gas, etc. Also state whether the liquid will flow steadily in pipe, or whether pulsations occur. If the liquid is pumped, state whether by reciprocating or centrifugal pumps.

7. Buried in ground, exposed on surface of ground or on girders or columns.

8. Short steel pipes can be galvanized up to ca. 20-ft. lengths. In the case of steam pipes, state what class of non-conducting lagging is preferred, and whether for indoor or outdoor use.

9–10. Slip joints, forged sleeve bolted joints, flange joints, etc. The particular type required should be specified and, in the case of flange joints to what standard, i.e. whether British, American, makers, etc.

12. On long lines these should be provided every 400–500 ft.

13. Fittings may be bends (90° or 45°), tees, crosses, Y-branches, ball joints

14. Is special anchoring required? If so, where is it necessary?
15. Enclose a dimensioned profile and contour map, if the pipe line is for hydro-electric purposes.
16. If for other purposes, send a dimensioned sketch showing proposed layout.

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(for small angle differences), reducers, etc. When any of the branches differ in size from the main the branch diameter should be specified. In the case of special fittings, send dimensioned sketch of the fittings required.

## PLANER, METAL, ELECTRICALLY DRIVEN

1. State type of planer.
2. Give dimensions of planer in feet. Length......
   Breadth Height.... ....
3. What is the weight of the table alone, in pounds ?
4. What is the maximum weight of the material to be planed in pounds ?
5. Give particulars of the material to be planed.
6. State number of tools cutting at one time.
7. Give dimensions of each cut in inches. Depth . . Width .. .....
8. State cutting speeds required, in feet per minute.
   Maximum . Minimum... .. Average..
9. State return speed required in feet, per minute.
10. What type of speed regulation is required ?
11. Give length of stroke in feet. Maximum . ..
    Minimum.... .
12. State maximum number of cycles run per minute.
13. Give particulars of how the planer table is driven.
14. State the efficiency of the drive.

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1. State whether an ordinary planer or one with a movable cutter holder.

5. Steel, cast iron, bronze, etc. When possible, give shearing strength in lb. per sq. in., and, in the case of steel, give its composition.

7. This question refers to the maximum cut. It should also be stated in what material this maximum cut will be made. In addition, the dimensions of the cut with which the bulk of the work will be done should also be given.

10. The following types of speed regulation may be obtained—

(*a*) Regulation of cutting speed only, return at constant speed.

(*b*) Regulation of both cutting and return speed, but cutting and return speed the same.

(*c*) Regulation of both cutting and return speed, but cutting and return speed independent of one another.

(*d*) Regulation of both cutting and return speed, but return speed either the maximum or the same as the cutting speed.

12. A complete cycle represents one cutting and one return stroke. The answer to this question is of particular importance when short strokes and rapid speeds are being used.

13. By rack or screw. If it is driven through a rack, state the speed of the belt-driven shaft (on the planer) at a given speed of planer table. If screw-drive, type and pitch of screw.

14. The efficiency given should be the overall efficiency from the point of drive to the cutting tool.

15. Are many auxiliary motors required? If so, give particulars.
16. State system, voltage and frequency of available supply.
17. If main system is alternating current, is continuous current available for excitation purposes?

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15. Such as for raising and lowering cutter bar or rapid movement of the cutters. If so, state h.p. and speed required in rotations per minute.

16. If the supply is private, particulars should be given. Then include number of units, size of each in kW. or kVA., overload capacity of each, how driven, and specimens of the average daily load curve. These need only be given if the planer is very large and the capacity of the system comparatively small, as variation in the load on the motor may cause variations in the voltage.

## PLANT, ASH REMOVAL

1. State total quantity of ash to be removed in lb. per hour. Average.. .. .... .Maximum. ..
2. Give full particulars of each boiler from which ash is to be collected.
3. Give particulars of the fuel to be used.
4. What method of ash removal is preferred ?
5. Give particulars of power supply available.
6. Are ashes to be used for manufacture of bricks, etc. ?
7. Are the ashes to be treated for the removal of small coal ?
8. Enclose dimensioned sketch showing foundations of all boilers.
9. Enclose a dimensioned sketch showing proposed layout.

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2. Number of boilers, type, name of maker, size (average and maximum), ratings in lb. of water from and at 212° F., and state whether forced or induced draught is employed.

3. Name of mine, size as fired, chemical analysis, calorific value in B.Th.U. per lb.

4. State whether wet or dry removal is preferred. The following methods may be employed : Into wagons under furnace ; bucket or screw conveyors ; into pits below furnace filled with water from which ash is removed by scrapers or buckets ; into channels through which water is kept continually circulating and which carries the ashes to outside containers ; high-water pressure injectors with a closed pipe system ; pneumatic suction. A pneumatic suction system is sometimes combined with the others to remove fine ash direct from boiler flues. The choice of system is to some extent governed by the quality of the fuel, make of boiler, etc.

5. Required for driving pumps, conveyors, etc. From existing transmission shaft or by electric motor. In latter case, state system, voltage, and frequency.

6. If so, is this plant also to be included ? Give particulars (i.e. size, for what purpose and any tests they must pass) of the bricks, paving stones, tiles, etc., to be made.

9. Plan and elevation required. This should show position of all boilers from which ash is to be taken, position at which ashes are to be dumped, proposed position of pump, etc., point where power is available, space available for pump, containers, ash grinder, cleaning apparatus, etc., when these are necessary.

## PLANT, BRIQUETTING

1. Give particulars of the class of material to be briquetted.
2. What will be the percentage of moisture in a normal sample of the material ?
3. What is the size of the material to be briquetted ?
4. Give size of briquettes required.
5. State hourly output required from the plant in tons.
6. How is the plant to be driven ?
7. Give particulars of steam supply available for drying material.
8. Give dimensioned sketch showing proposed layout.

---

1. State whether coal (bituminous, brown coal, etc), sawdust, metal turnings (state metal, etc.) is to be used. Has the coal been washed ? If two classes of coal are to be mixed, give percentage of each in mixture. In case of metal what is the condition of the metal ?

3. In case of coal, give the standard trade designation ; in other case describe as well as possible, or state percentage passing through a specified sieve.

4. This should state shape, square, round, oval, etc., dimensions and weight in lb.

6. If from an existing transmission, state speed and available h.p. If from a steam-engine, it will be assumed steam supply will be as given in answer to question 7. If by an electric motor, state supply, voltage, and frequency available.

7. Steam pressure in lb. per sq. in. abs , and temperature in ° F.

# PLANT, COLD STORAGE

1. State quantity of material to be chilled or frozen in tons per 24 hours.
2. Give particulars of the material to be handled.
3. Give the capacity of the chambers to be refrigerated in cubic feet.
4. State the temperature to be maintained steady in the chamber in ° F.
5. Give particulars of the construction and insulation of the rooms.
6. What system of cooling is preferred ?
7. State quantity of water available, for condensing purposes in gal. per hour.
8. What is the temperature of this water in ° F. ?
   Average...... ..Maximum. . ......Minimum. ..
9. State the quality of this water.
10. What is the air temperature at the site in ° F. ?
    Average.. . .. Maximum. . . . Minimum.
11. How is the plant to be driven ?
12. Give dimensioned sketch showing proposed layout of plant.

---

2. State whether beef, mutton, rabbits, eggs, fruit (give kind), etc., are to be chilled or frozen. If the material is already chilled or frozen when placed in the chamber give its average temperature in ° F. If this is not stated, it will be assumed that warm meat, etc., is to be dealt with.

3. State what length, breadth, and height are to be used.

5. Dimensioned section of the walls, ceiling, and floor should be given on the sketch asked for in question 12, and state what quality of insulation will be used.

6. State if by ammonia or carbonic acid process and whether a direct expansion, brine circulation or air circulation system is preferred.

9. State whether clean or muddy, gritty, corrosive. etc.

11. If by a steam-engine, give pressure in lb. per sq. in. abs., and temperature in ° F. of the steam available. and state whether a condensing or non-condensing engine is to be offered. If the former, state the vacuum at the engine exhaust, or is a condensing plant also to be offered ? If a locomotive type engine is to be offered, state class, quality, and calorific value of the fuel. If by an electric motor, state the system, voltage, and frequency available. If by a gas or oil engine, state quality and calorific value of fuel.

# PLANT, CREOSOTING TIMBER

1. State number of sleepers to be treated per eight-hour day.
2. Give dimensions of the sleeper to be handled.
3. State what process of creosoting is preferred.
4. Are sleepers also to be seasoned ?
5. Give particulars of the fuel to be used with boiler.
6. Is a supply of good water available ?
7. What accessories are to be included ?
8. Enclose dimensioned sketch showing proposed layout.

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1. Sleepers, poles, etc. They will be assumed seasoned unless question 4 is answered in the affirmative. If the quantity of creosote which is to be pressed into the timber is specified, usually 10 lb. per cub. ft., this should also be stated, as well as the class of timber and region from which obtained.

3. Rueping, Lowry, full cell, or Bethell.

4. Boulton process can be used to season the timber. Green timber is immersed in a cylinder charged with hot creosote oil and a vacuum applied. As the pressure falls the oil is kept at a temperature above that at which water boils. The water is condensed in the condenser. When practically all the water is removed more oil is pumped in, and final pressure applied till desired impregnation is obtained.

5. Name, size, calorific value

7. Feed pump, water injector, storage tank.

## PLANT, DEGASSING

1. State total quantity of feed water to be dealt with in gal. per hour.
2. State quantity of make-up feed water added in gal. per hour.
3. Is this make-up water fresh or distilled ?
4. Give the temperature of the feed water at the inlet to extractor plant in ° F.
5. State the amount of air to be extracted in cub. ft. per hour.
6. State system of air removal preferred.
7. Is a regenerative degasser required ?
8. Is exhaust steam available for heating the feed ? If so, state quantity in lb. per hour.
9. Give particulars of any power available for driving pump when used.
10. Enclose a dimensioned sketch showing proposed layout of plant.

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1. i.e. total quantity going into boilers.

5. It may be difficult to supply this information with accuracy. If so, in the case of fresh water make-up, state whether the water is sparkling and pure, from what source it is obtained, i.e. mains, river, canal, etc., and whether it has been previously treated for softening.

6. This may be by agitation, boiling, vacuum, or a combination of these three, or by chemical means.

7. By the "Paris" system, using manganese cast iron as degassing agent.

9. i.e. h.p. available, speed of shaft; indicate position of shaft on plan.

10. This should indicate proposed position of degassing plant with reference to boilers, etc.

## PLANT, DUST REMOVAL

1. Give full particulars of the work done in the shop.
2. Indicate on plan number of points from which air will be extracted.
3. State number of workpeople employed in room.
4. Indicate on plan where dust-laden air may be discharged.
5. Is the air to be filtered before discharge ?
6. How is fan to be driven ?
7. Enclose dimensioned plan and elevation of building.

---

See also installation, ventilating.

1. Knife, etc., sharpening plant, buffing and polishing plant, carpet surfacing machinery.

2. When the dust is raised by a machine it is advisable to place an exhausting cap or hood over each machine. Each machine to be so treated should be shown on plan.

4. The point should be chosen so that no nuisance will be caused by the dust.

5. This is sometimes done to recover valuable metal dust or to avoid creating a nuisance. In this case see also data sheet for air filter.

6. From transmission, indicate position and state speed in r.p.m. ; if by electric motor, state system, voltage, and frequency.

7. This should indicate all machines and all floors which have to be dealt with, as well as point of discharge for air and proposed position of fan or fans.

## PLANT, EXTRACTION

1. What class of raw material will be employed ?
2. Give full particulars of the material as supplied to plant.
3. What materials are to be extracted from the raw material ?
4. State percentage purity of the finished materials required.
5. How is the residue to be dealt with ?
6. State whether a continuous or intermittent process is desired.
7. Give particulars of the fuel to be used.
8. Give particulars of any steam supply available.
9. Give particulars of water supply available.
10. Enclose dimensioned sketch showing proposed layout.

---

1. Oil seed, wood, earth, bones (fresh or old), fish meal, meat meal, bark, liquid concentrates, etc.

2. Liquid or solid ; in case of solid whether in lumps or powder (state average size of lumps or percentage of powder left on sieve of a specified size) ; in case of a liquid, state the concentration ; percentage of moisture in average sample ; chemical analysis. Temperature of material as supplied to plant in ° F.

3. Oil, fat, wax, tan, aether, acetone, benzine, chloroform, etc. ; more than one of these products may be extracted at same time. This will depend on material to be handled, process used, and purpose for which finished materials are required.

5. Is it to be delivered dry or wet, in mass or briquetted, etc. ? If it is to be used in connection with any other process (such as, converting bone meal into charcoal), give particulars and say if necessary apparatus for this process is to be included.

7. Coal, coke, oil, gas, etc., calorific value in B.Th.U. per lb., etc.

8. Fresh or exhaust, quantity available in lb. per hour, pressure at plant in lb. per sq. in. abs., temperature in ° F.

9. Chemical analysis may be necessary ; quantity available in gal. per hour.

## PLANT, GAS CLEANING

1. State the quantity of gas to be cleaned in cub. ft. per hour.
2. Give the temperature of the gas at entrance to cleaning plant in ° F.
3. State pressure of gas at entrance to cleaner in inches w.g.
4. From what source is the gas obtained ?
5. Give chemical analysis of the gas.
6. State the amount of dust contained in the uncleaned gas in grains per cub. ft.
7. State amounts of moisture and tar contained in cub. ft. of uncleaned gas.
8. To what extent must the gas be cleaned ?
9. For what purpose will the gas be used ?
10. Give particulars of cooling water available.
11. Give particulars of the electrical supply available.
12. Give dimensioned sketch showing space available for the plant.

---

1. Answer to be given at 0° C. and 760 mm. pressure.
4. Blast furnace, state whether coal or coke fired, coke ovens, etc.
8. Express as the maximum amount of dust, etc., which may be left in the gas, in grains per cub. ft.
9. Gas engines, stoves, boilers, etc.
10. State source, quantity in gal. per hour and pressure in inches w.g.
11. State system, voltage, and frequency.

## PLANT, ICE MAKING

1. State quantity of ice to be produced per day, in tons.
2. How many hours per day will be worked ?
3. State thickness in inches and weight in pounds of the block preferred.
4. What class of ice is required ?
5. Is an ammonia or carbonic acid gas plant preferred?
6. State quantity of water available for condensing purposes in gal. per hour.
7. What is the temperature of this water in ° F. ?
   Average.... .....Minimum. .... Maximum..... ......... ..
8. State quality of this water.
9. How is the plant to be driven ?
10. What is the air temperature at the site in ° F. ?
    Average...... ..........Minimum. . .. .Maximum... ........ .
11. Enclose dimensioned sketch showing space available for plant.

---

4. Is white or clear ice required ? State whether cell, can, or agitated can ice is preferred.
8. Is the water clear, muddy, gritty, corrosive, etc.
9. If by a steam engine, give pressure in lb. per sq. in. abs., and temperature in ° F. of the steam available, and state whether a condensing or non-condensing plant is to be offered. In former case, state vacuum at engine exhaust, or is condensing plant also to be offered ? If by an electric motor, state system, voltage, and frequency of supply available. If by gas or oil engine, state quality and calorific value of the fuel. If a locomotive type engine is to be used, state class, quality, and calorific value of the fuel.

## PLANT, IMPREGNATING

1. State maximum number of articles to be impregnated per hour.
2. Give dimensions of the article.
3. Give general description of the construction of the article.
4. Give particulars of the impregnating material to be used.
5. How is this material to be heated ?
6. Give particulars of any steam supply available.
7. How is plant to be driven ?
8. Give particulars of electricity supply.
9. Enclose dimensioned sketch of proposed layout.

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See B.S.S., No. 144.

2. This should be first for the largest articles and second for the average run. When possible, enclose a dimensioned sketch of the article.

3. This should give some idea of the density of the article and its capacity for absorbing the impregnating material. Also state whether the article must first be dried.

4. Compound or varnish, its chemical composition or trade designation, and melting point in ° F.

5. By steam or electrically.

6. Live or exhaust, quantity in lb. per hour, pressure in lb. per sq. in. abs. If no steam is available, is a boiler to be offered ? In which case, state fuel to be used and its calorific value in B.Th.U. per lb. or cub. ft., as case may be.

7. From transmission, state speed ; or by electric motor.

8. System, voltage, and frequency.

## PLANT, LIQUID COOLING

1. State quantity of liquid to be cooled in gal. per hour.
2. State temperature of liquid before cooling, in ° F.
3. State temperature of liquid required after cooling, in °F.
4. Give particulars of the liquid to be cooled.
5. How is the liquid to be cooled ?
6. State quantity of water available for condensing purposes in gal. per hour.
7. What is the temperature of this water in ° F. ?
   Average. Maximum Minimum .
8. State quality of this water.
9. What is the air temperature at the site in ° F. ?
   Average. . Maximum. Minimum
10. How is the plant to be driven ?
11. Give dimensioned sketch showing space available for plant.

---

4. State the name, specific heat, and specific gravity of the liquid.

5. State if by ammonia or carbonic acid process ; direct expansion or brine circulation system.

8. State if water is clean, muddy, gritty, corrosive, etc.

10. If by a steam engine, give pressure in lb. per sq. in. abs., and temperature in ° F. of the steam available, and state whether a condensing or non-condensing engine is to be offered. In the former case, state the vacuum at the engine exhaust, or is a condensing plant also to be offered ? If by an electric motor, state system voltage, and frequency of the supply available. If by gas or oil engine, state quality and calorific value of the fuel. If a locomotive type engine is to be used, state class, quality, and calorific value of the fuel.

## PLANT, METAL CUTTING

1. What class of metal is to be cut ?
2. State maximum thickness of metal to be cut, in inches.
3. What gas mixture is preferred ?
4. Is hand or electric operation preferred ?
5. Is gas supply available ? Give particulars.
6. Will more than one cutter be in use at one time ? State number of flames simultaneously in use.

---

1. Forged iron, steel, cast-steel, etc.
2. Also state profile of the material to be cut, viz., angle iron, channel iron, rails, plate, etc.
3. Acetylene-oxygen, hydrogen-oxygen, etc.
5. If not, is a complete gas producing plant also to be supplied ? In this case also enclose dimensioned plan showing proposed layout for gas producing plant, and state whether piping is to be included.
6. When more than one is in use, state size of each flame.

## PLANT, OZONIZING

1. What is the class of building to be deodorized, and for what purpose is it used ?
2. Give a detailed description of the smells or fumes to be removed.
3. Give a description of the manufacturing processes to be carried on in each room.
4. If a living room, state the average number of people present in the room at one time.
5. Is there a ventilating system in use at present ? If so, give description.
6. State volume of air in cub. ft. per minute extracted from the room by this system.
7. Give description of any special precaution taken under present conditions.
8. State any special requirements desired.
9. Give detailed dimensioned sketch of the buildings.

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9. The sketch should also show the layout of any ventilating system employed, and should give the size of fans, ducts, etc., provided.

# PLANT, PULVERIZED FUEL

1. State capacity of plant required in tons per hour.
2. Give full particulars of the fuel to be pulverized.
3. With what class of plant will pulverized fuel be used ?
4. If drying is necessary, how is the dryer to be driven?
5. Can hot gases be tapped from the flue for drying the coal ?
6. What type of grinding plant is desired ?
7. How is the pulverized fuel to be transported to the boiler ?
8. Is an existing supply of compressed air available ? Give particulars.
9. Send a dimensioned drawing of the plant in which the coal is to be fired.
10. Send a dimensioned sketch of the boiler house, showing proposed position of plant.

---

1. Or give such particulars of the plant, with which it is to be used, as will enable this figure to be calculated ; such, for example, as normal evaporative capacity of all boilers working together in lb. per hour from and at 212° F., etc.

2. Class of fuel ; coal, coke, lignite, etc. ; name of colliery ; size of fuel ; chemical analysis of fuel (see data sheet, page 13) ; percentage of moisture, and melting point of ash is important ; calorific value in B.Th.U. per lb.

3. Boilers ; state whether Lancashire, Babcock & Wilcox, Stirling, etc. ; muffle furnaces ; annealing furnaces ; forge furnaces ; tool-heating furnaces, etc.

4. If there is a transmission shaft available for driving this section, state its speed and size of available pulley, in ft.

5. If so, indicate the point of extraction from flue on plant (question 10).

6. Ball mill or crusher, central, or one per boiler.

7. Can be transported as follows—
(*a*) By screw conveyor to boiler hoppers, suitable up to ca. 100 yd.
(*b*) By cable with discs to boiler hoppers, suitable up to ca. 100 yd.
(*c*) By wagons and crabs to boiler hoppers, suitable up to ca. 100 yd.
(*d*) By high-pressure air to boiler furnace, 2·5 – 4·5 At. per sq. in.
(*e*) By low pressure to boiler furnace, 0·04 – 0·05 At. per sq. in.

8. If existing mechanical draught fans or other source of compressed air is available, state size, speed, output, and pressure in inches w.g., which fan can supply, indicate its present position on plan (question 10) and give diameter and length of any connecting pipes. If other source of compressed air, give its pressure in atmospheres, and quantity of free air available in cub. ft. per minute.

9. This should contain full dimensions of the furnace chamber and all obstructions, such as bridge walls, etc., in it.

## PLANT, SAND BLASTING

1. For what purpose will the sand blast be used ?
2. State output required from plant.
3. Give particulars of the material to be treated.
4. State dimensions of largest piece to be handled.
5. Is a suitable compressor to be included ?
6. Enclose dimensioned sketch showing proposed layout.

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1. Blasting labels on bottles, producing ground glass, cleaning shell, cleaning castings, etc.

2. Number of bottles to be handled per hour, square feet of glass per hour, number and calibre of shell, number and weight of castings to be cleaned per hour; in latter case, state percentage of castings which can be cleaned in barrel, i.e. that are less than 50 lb. in weight.

3. Glass, iron, steel, or brass castings, etc.

5. If so, enclose completed data sheet for air compressor.

6. This should show proposed position of compressor and its drive, position of sand drum and each apparatus using blast.

## PLANT, SCREENING

1. State nature of raw material to be screened.
2. State the maximum quantity of material to be handled per day in tons.
3. State the maximum quantity of material to be handled per hour in tons.
4. How many classes of the material are to be made ?
5. Give size of each class.
6. Give approximate quantity of each class per day in tons.
7. Where is the screened material to be delivered ?
8. How is the spoil to be disposed of ?
9. What is the clear head room under the picking floor, in feet ?
10. What is the height of the pit bank above rail level in the screen house, in feet ?
11. What is the distance from the bank to the screen house, in feet ?
12. Give size and details of pit tubs.
13. Give sizes, position and particulars of any wagon rails which are to be utilized.
14. How is the screening plant to be driven ?
15. Give dimensioned plan showing proposed layout.

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1. State name of raw material, coal, iron ore, gravel, etc.; give size of largest pieces in inches; state whether wet or dry and, if wet, state percentage of moisture content of an average sample. When very fine sifting is required, it is advisable to submit a sample of the material.

5. This should give the trade designations in the case of coal, or the size of each screen (meshes per inch) to be used.

7. Into railway wagons, carts, barges, ships, or for storage.

12. A sketch of the tubs should be sent if available.

14. If it is to be driven from an existing shafting, give the relative position of this shafting to the screening plant, state its speed in r.p.m., give diameter pulley, and state what h.p. is available for driving the screening plant. If it is to be driven by a steam-engine, state steam pressure in lb. per sq. in. abs.. and temperature in ° F. available for engine. If it is to be electrically driven, state system, voltage, and frequency available.

15. This should show position of screening plant with reference to pit head, all rails which may be used with their gradients and curves, position of dump for spoil if this is to be used, and delivery point for screened material.

# PLANT, SHIP DISCHARGING

1. State nature of material to be discharged.
2. State quantity of material to be dealt with in tons per hour. Maximum .... ..Average .....
3. Give full particulars of the vessel to be discharged.
4. State variations in tides and distance of lowest water level from quay surface, in feet.
5. Give height of bulwarks above water level with vessel fully-loaded and vessel empty, in feet.
6. Does vessel rest on bottom at low water ?
7. Into what receptacle is the material to be discharged ?
8. Is the plant to be fixed, travelling, or floating ?
9. Is a weighing or counting attachment to be fitted ?
10. State maximum vertical distance in feet that the material is to be raised, measured from quay surface.

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In the case of ship loading plant, this data sheet should be sent in together with completed data sheet on aerial ropeway, conveyor, transporter, etc., dealing with the manner in which the material will be brought from the mine, quarry, etc., to the quay. Where no quays are available and the ship is to be loaded at some distance from the shore, a detailed contour map of shore and sea (showing heights of land above and depth of bottom below sea-level) should be included for some considerable distance on either side of the proposed site, so that possible alternatives may be considered.

1. Sand, gravel, grain, coal, sacks, boxes, etc., weight per cub. ft. in lb., dry or wet, size of average piece. The type of discharging plant offered will be fixed by the material to be handled but, in the case of some material, pneumatic handling can be employed instead of grab. State which type of apparatus is preferred.

2. State also the number of hours the maximum demand may last, also how many hours per day the plant will be used.

3. Type of vessel, registered tonnage, number of hatches, size of hatch (length and width), distance of centre of hatch from side of vessel. Enclose a drawing of the vessel when this is available. These particulars should be given for largest vessel to be handled.

7. Warehouse, railway trucks, dump, etc.

8. See also data sheet for floating crane.

If plant is to be floating, the following additional information is required—

(a) Are the dimensions of the pontoon limited in any way ?

(b) Is pontoon to be self-propelling ? If so, state speed.

(c) Is electric supply to be obtained from shore, or is generating plant to be included on pontoon ?

11. State maximum horizontal distance, in feet, that the material is to be conveyed, measured from quay edge.
12. Has the discharging plant to clear any obstruction ? Give particulars.
13. How is the discharging plant to be driven ?
14. Is discharging to be carried on at night ?
15. Enclose dimensioned sketch showing proposed layout.

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12. Such as railway trucks, dump, etc.

13. May be driven from existing transmission shaft, in which case state speed in r.p.m. and show its position on sketch ; by electric motor, in which case state system, voltage, and frequency, and if a point of supply near proposed site is available.

15. This should show position of warehouse or railway trucks, number of floors, maximum horizontal travel required, all points where material has to be delivered, details of any obstructions to be cleared, etc., all distances measured from quay surface or quay edge. On shore map, contours should be at 10 ft. intervals. Draw attention to any positions where supports, etc., cannot be placed.

## PLANT, TIMBER SEASONING

1. State quantity of timber to be dealt with per day of 24 hours, in cub. ft.
2. Give maximum lengths, breadths, and thickness of timber to be handled, feet or inches.
3. Give average thickness of timber, inches.
4. Give full particulars of the timber to be dried.
5. Has timber been partially air dried ?
6. Give particulars of any exhaust steam available.
7. Enclose dimensioned sketch showing proposed site and layout.

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1. If continuous seasoning is not carried on, state number of working hours per day.
2. These need not necessarily occur together, but will fix size of chamber.
4. Name from what country timber was obtained, when felled, and approximate number of months timber has been felled.
5. If so, state how long, or is timber straight from saw ?
6. Quantity in lb. per hour, pressure in lb. per sq. in. abs., and source. If live steam only is available, give similar particulars. State when and for how many hours per day exhaust steam is available.
7. This should show proposed site for plant, method of handling timber, and distances from exhaust or live steam supply.

## PLANT, WATER DISTILLING

1. State maximum quantity of distilled water required in gal. per hour.
2. Can plant run 24 hours per day ?
3. For what purpose is the water to be used ?
4. Give particulars of the water to be distilled.
5. Can this source of water also be used for cooling purposes ?
6. Give particulars of any steam supply available.
7. Give particulars of the fuel to be used.
8. Where is plant to be used ?
9. Is the distilled water to be aerated ?
10. Is an automatic self-cleaning plant required ?
11. Enclose dimensioned sketch showing proposed layout.

---

1. If this demand does not last 24 hours, state total quantity of distilled water required in the 24 hours, in gal. The plant can then be run at a lower rate, and water stored during slack hours to meet maximum demand.
3. Laboratory, medical, drinking, or boiler feed.
4. Fresh or salt, clean, muddy, etc., weight and chemical composition of salts contained per gal.
5. If not, give particulars of the cooling water which may be used, i.e. source, quantity available in gal. per hour, and temperature in ° F.
6. Live or exhaust pressure in lb. per sq. in. abs., and temperature in ° F.
7. Name, size, calorific value in B.Th.U. per lb.
8. On ship or land.

## PLOUGH, ELECTRICALLY DRIVEN

1. What is the principal work on the farm ?
2. What is the nature of the soil ?
3. Give thickness and particulars of the different layers ploughed.
4. Are the deep layers stoney ?
5. Are the fields flat or hilly ?
6. Are there any ditches in the fields ? If so, give sketch showing number and position.
7. Are the fields drained ? If so, state how.
8. What is the total area in acres under plough ?
9. Of this area, how many acres are under—
   (*a*) Grain. (1) Winter sowing.
   (2) Spring sowing.
   (*b*) Roots. (1) Potatoes.
   (2) Turnips or swedes.
   (3) Beets.
   (*c*) Other crops.
10. Give particulars of yearly ploughing programme for each crop specified under 9.
11. Give particulars of how the land is ploughed at present.
12. State system, voltage, and frequency of supply available.
13. Give particulars of power station equipment from which supply will be taken.

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10. This should include : (*a*) Type of crops specified under (9). (*b*) Type of furrow, deep, shallow, dung, etc. (*c*) Depth of furrow in inches. (*d*) Dates on which ploughing is done.

11. By steam plough or by use of horses, oxen, etc. If animals, state number of animals used per plough.

13. This should include distance of central station from farm in yards or miles. Number of units, size of each unit in kW. or kVA., overload capacity of each unit, type of prime mover used, and specimen of average daily load curve. If the farm is fed through a sub-station, the size of transformer and average daily load on it should be given in addition to above information.

## POND, COOLING

1. State quantity of circulating water to be cooled in gal. per minute.
2. What is the maximum temperature of the circulating water on leaving the condenser in ° F.
3. Under what head will the water be delivered to spray, in inches w.g. ?
4. State reduction in temperature desired in ° F.
5. Give full particulars of the atmospheric conditions in the locality where the pond is to be erected.
6. Give sketch showing proposed situation of cooling pond.

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4. This should include the maximum, minimum, and average air temperature and humidity occurring during the year. If daily records over a year are available, these should be sent.

6. If this space is at all restricted, a detailed sketch should be sent, giving the size of the space available. Should a pond be already in existence, its size, including the depth, should be given. If it is proposed to place the pond on the roof of a building, full particulars of the building structure should be given in order to check its capacity for carrying the additional weight. The sketch should particularly indicate the prevailing direction of the wind, and the presence of any surrounding buildings which are likely to obstruct a free passage of cold air over the pond.

## PRESS, BALING

1. State size of finished bale required.
2. State weight of finished bale required.
3. Give particulars of the material to be baled.
4. State hydraulic pressure available in lb. per sq. in. g.
5. Is hydraulic gear to be offered ?

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If size of press is known, state stroke, size of table, size of head, distance between columns, all in feet, instead of answering questions 1 and 2.

1. Length, breadth, and thickness.
3. Cotton, jute, wool, hides. State weight of a cub. ft. of the material in its raw condition.
5. If so, enclose data sheets for pump, pipes, and accumulator.

## PRESS, BRIQUETTING

1. For what class of work is the press required ?
2. Give particulars of the material to be dealt with in its raw state.
3. Give dimensions of finished briquette required.
4. State quantity of briquettes to be made in lb. per hour.
5. What system is preferred ?
6. How is the press to be driven ?
7. Is press to be fitted with drying or heating apparatus ?
8. Is press to be fitted with automatic feed, automatic ejection, or both ?
9. Enclose dimensioned sketch showing proposed layout.

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See also data sheet for Plant, Briquetting.

1. Coke dust, coal dust, ashes, small coal, brown coal, ore, cement, sawdust, shavings, feeding cake for cattle, etc.

2. Name, size as fed to press, percentage of moisture, percentage of oil, etc., chemical analysis in case of coals.

3. Dimensions in inches, also state weight of briquette required in lb.

5. Wet or dry, choice will depend to some extent on the material to be pressed.

6. By friction gear, from transmission shaft, by hydraulic power or compressed air (state pressure available at press in lb. per sq. in. abs.), by electric motor (enclose data sheet).

## PRESS, FILTER

1. State quantity of liquid to be filtered in gal. per hour. Average.. . .. ...Maximum ..
2. How long may maximum demand last ?
3. Give full particulars of the liquid to be filtered.
4. What type of press is required ?
5. Is a forcing ram to be used ?
6. If so, give particulars of compressed air supply available.
7. If not, state what type of drive is preferred for the pump.
8. Enclose dimensioned sketch of proposed layout.

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3. This should state name of fluid to be handled, quantity of solid matter it contains in lb. per gal., full particulars of this material, name, hard or soft, specific gravity (dry), etc.

1–3. If size of press is known, this may be given instead of answering this question. Thus, state thickness of cake required in inches and volume or dimensions of press chambers.

4. Non-washing or through-washing type.

6. Pressure in lb. per sq. in. gauge.

7. From transmission, state speed in r.p.m., by motor, etc., enclose a completed data sheet.

8. Should show position of press, incoming and outgoing pipes. position of drive for pump, etc.

## PRESS, FORGING

1. State nominal power of the press required, in tons.
2. For what class of work is the press mainly used ?
3. Give particulars of the largest piece to be handled.
4. Give specification of the material to be dealt with.
5. State maximum number of finishing strokes required per minute.
6. How is material to be handled whilst being forged ?
7. What type of forge is preferred ?
8. How is forge to be driven ?
9. Enclose dimensioned sketch showing proposed layout.

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This data sheet may also be used for presses for straightening large shafts, bending armour or ship plates, drawing, etc.

2. Cogging, turbine discs or drums, shafts, etc.
3. Length, breadth, thickness (or diameter), and weight.
4. Nature of steel, composition, and strength.
6. By overhead crane.
7. Overhung or two columns. Choice will, to some extent, depend on work to be done.
8. If by steam pressure, state pressure in lb. per sq. in. abs., and temperature in ° F., and whether engine is to exhaust against back pressure (state pressure in lb. per sq. in. abs.). If by hydraulic power, state pressure in lb. per sq. in. g.

If the necessary hydraulic gear is to be included, enclose data sheets for pump, piping, and accumulator.

## PRESS, POWER

1. For what class of work is the press required ?
2. State dimensions of the object to be dealt with in its raw state.
3. Give dimensions of the object to be dealt with in its finished state.
4. Give particulars of material to be dealt with.
5. What type of press is preferred ?
6. Is the stroke to be adjustable ?
7. How is press to be driven ?
8. Is the press to be fitted with withdrawing cylinder ?
9. Are the press plates to be heated ?
10. What method of heating is preferred ?

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See also data sheet for forging press if this does not appear suitable for work to be done.

1. Trimming drop-forgings, disc stampings, flanging press, sleeper press, troughing press, shaft straightening press, shell press.

2–3. State length, breadth, thickness, and weight. Whenever possible, enclose fully-dimensioned sketch of object to be handled in raw and finished conditions.

4. Name, composition, hardness, temperature in ° F.

5. Single or duplex pattern, overhung or two column type.

7. By friction gear, from transmission, state speed ; by hydraulic power or compressed air, state pressure available at press in lb. per sq. in. g. ; by electric motor, enclose data sheet.

9. This will depend on the work to be done in press.

10. When necessary, state whether by steam, gas, or electricity. State steam pressure in lb. per sq. in. abs., and temperature in ° F. and for electricity voltage.

## PRESS, PRINTING, ELECTRICALLY DRIVEN

1. State what type of press is to be driven.
2. What is the speed of the shaft to be driven in r.p.m. ? Maximum ... ... Minimum ... ..
3. Is an " inching-in " speed required ?
4. If so, give this speed in r.p.m. and state for how long it is required in minutes.
5. Is speed regulation required ?
6. What h.p. is required at following speeds ? Maximum speed h.p . . .. Minimum speed h.p. .... . .. .....
7. What starting torque is required ?
8. Give particulars of how the press is to be driven.
9. Is push-button control from different points of the press desired ?
10. If so, state number of points and class of control required.
11. Is the hand control lever to be connected with the controller ? If so, state whether mechanically or electrically.

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1. State whether press is rotary machine, flat bed, jobbing, etc.

2. This only refers to printing speeds, and does not include " inching-in " speed.

5. If so, give range.

6. The h.p. required at the minimum printing speed should be estimated with care, as too high a figure will necessitate a motor larger than really required. This is of particular importance if most of the printing will be done at or near maximum speed.

7. This will depend on the make and type of press. It should be stated as a percentage of maximum the torque required (which should correspond to the maximum h.p. given in question 6).

8. Is the motor to be direct-coupled to the press or to drive it through belt, chain, or gear ? If either of the last two should be the case, is any particular speed ratio desired or is the choice of the motor speed free.

10. State whether stop ; start and stop ; start, stop and speed control is required.

11. The hand control lever should only be connected with the starter or controller in the smaller sizes. It is preferable to so connect it electrically that, on working the lever and putting on the brake, the motor is automatically switched out.

12. Is electric braking desired or is a brake magnet to be provided ?
13. Is the slow speed for " inching-in " to be obtained by a separate motor ?
14. Will the machine be driven by more than one motor ? If so, state how many.
15. State system, voltage, and frequency of supply available.
16. Give dimensioned sketch of the press showing space available for the motor.

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12. If a brake magnet is to be provided, give answers to the relative questions on brake magnet data sheet.

13–14. Apply only to rotary printing machines.

13. The necessary gearing between the small motor and the machine or large motor should be provided by the printing press manufacturer. When preparation is complete, the speed of the small motor is usually increased till the large motor can take up the load without jerk.

14. This may occur in four or more roll machines, in which the motors may sometimes run alone and sometimes together. Full particulars should be given of the arrangement proposed.

16. In many types of printing presses the motor can be put inside the printing press frame. This may, however, limit the size of motor which can be used, and hence fix the speed.

## PRODUCER, GAS

1. What kind of gas is required ?
2. State quantity of gas required in cub. ft. per min.
   Maximum Average...
3. Is the gas demand steady or variable during the day ?
4. In the latter case, state maximum and minimum demands and time in which this change is likely to occur.
5. State calorific value of gas required in B.Th.U. per cub. ft.
6. Give full particulars of the fuel available for the gas production.
7. What is the calorific value of the fuel in B.Th.U. per lb. ?
8. For what purpose will the gas be used ?
9. Is a steam supply available for the producer ? If so, give particulars
10. Are there any exhaust gases of more than 200 ° F. temperature available ?
11. If so, state quantity in lb. per min. and temperature in ° F.

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1. Mond gas, water gas, etc.

2. Gas producers are not suitable for carrying overloads, consequently the quantity of gas required should be estimated with care. If the quantity of gas required is not known, then full particulars of each furnace to be heated, giving size of furnace, temperature required in ° F., size and weight of articles to be heated, number of articles at one heat in furnace, or total weight of batch and number of hours per heat should be given. If the furnaces are already in use, state the daily consumption of fuel in each furnace and number of hours in heat, and the calorific value of the fuel used. In the case of steam boilers, state quantity of water to be evaporated in lb. per hour, boiler pressure in lb. per sq. in. abs., and superheat required in ° F. In the case of gas engines, state maximum continuous b.h.p. required.

6. State type of fuel, anthracite, bituminous coal, lignite, nut shells, shavings, coke, etc., size of fuel; give an analysis of the fuel, particular attention being paid to the sulphur content.

8. Gas engine, plate forge, or tool furnaces, core stoves, galvanizing baths, etc.

9. State whether live or exhaust; steam pressure in lb. per sq. in. abs.; temperature in ° F. at point where producer will be erected, and quantity in lb. per hour available for the gas producer.

12. Is a supply of cooling water available ?
13. If so, state source, quantity in gal. per hour, and average temperature in ° F.
14. Can this water run to waste, or is a cooling tower to be used ?
15. State system, voltage, and frequency of electric supply available.
16. Are by-products to be recovered ?
17. Is plant to run for long periods continuously ?
18. Enclose dimensioned sketch showing proposed layout

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17. In such cases, state how often (i.e. after many hours continuous running) and for how long plant may be shut down.

18. This should show the point where the coal is delivered, where and how the ashes are to be removed, proposed position of the gas producer, positions of the various furnaces with their gas demand in cub. ft. per hour against each, position of steam and water supply, etc.

## PROTECTION, SHORT-CIRCUIT

1. What is the apparatus to protect ?
2. Give particulars of the supply.
3. Is neutral point earthed ?
4. State full-load output in kVA. and percentage overload capacity for each generator and transformer to be protected.
5. State low tension voltage and type of connection used for all transformers to be protected.
6. What system of feeder protection is to be used ?
7. State full-load current flowing in feeder.
8. Give particulars of feeder.
9. How many feeders are working in parallel ?
10. Enclose a line diagram of connections of the plant to be protected

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See also data sheet for relay, reactance coil, leakage indicator.

1. Generator, transformer, feeder, overhead line.
2. System, voltage, and frequency (of apparatus to be protected).
3. If earthed through a resistance, state amount of resistance used.
5. Star or delta.
6. Merz-Price or split conductor (the latter method requires special cables), differential, selective, etc.
8. Section of cores, construction of cable (single-, two-, three-, four-, or six-core method of insulation and armouring), lengths in yards.
10. This should be a diagram of connections for all apparatus in station and fed from station. Those parts which are to be protected against short-circuit should be specially indicated.

This data sheet may also be used for protection against dead earth, but in this case it should be specially stated that this form of protection is desired.

## PULLEY, JOCKEY, FOR BELT DRIVE

1. State continuous h.p. to be transmitted.
2. What is the distance between the driving and driven shaft in feet ?
3. State diameter of pulley in inches. Driver
 Driven
4. State width of belt in inches.
5. State speed of belt in feet per minute.
6. Is a fast and loose pulley used ?
7. Show direction of rotation of the belt on the sketch.
8. State atmospheric conditions under which belt will be working.
9. Is load steady or fluctuating ?
10. Is the load impulsive or subject to shocks ?
11. Is the direction of rotation to be reversed ?
12. Give sketch of existing layout.

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8. This should state whether there is much moisture, steam, or chemical fumes present, and whether oil or water is likely to get on to the belt.

12. As the jockey pulley has to be fixed, the sketch should show the heights of the centres from floor-level, the horizontal distance between the centres, and their distance from the nearest wall, all in feet, for the existing drive. If it would be more convenient to suspend the jockey pulley from the ceiling, the height of the room in addition to the above dimensions should also be given. If either the driving or driven machine has outboard bearings, this should be stated. The sketch should also contain a rough block plan and elevation of the driving and driven machines to show the space available for the jockey pulley.

## PUMP, AIR LIFT

1. Give quantity of water to be pumped in gal. per minute.
2. State height above ground level to which it has to be pumped, in feet.
3. State the depth of the water level in the well below the desired discharge level, in feet.
4. What is the total depth of the well below the discharge level, in feet ?
5. What is the temperature of the water to be pumped ?
6. What is the condition of the well casing ?
7. Give diameter of well casing in inches.
8. If the well has already been worked, give full particulars of the existing pumping plant.
9. Give dimensioned sketch showing space available at the head of the well, and proposed layout of plant.
10. Is compressed air supply available ? If so, give quantity of free air in cub. ft. per min., and pressure at top of well in lb. per sq. in. abs. available for use in the pump.

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8. This should include type, size of pump, and discharge obtained from it. Is the air lift pump to replace the old pump or act in conjunction with it ?

## PUMP, BOILER FEED

1. State quantity of water to be pumped in gal. per hour. Normal . Maximum . ...
2. Give pressure required at pump outlet in lb. per sq. in. abs.
3. What is the maximum temperature of the water at the pump inlet in ° F. ?
4. What is the suction lift in feet ?
5. Has the water been chemically treated before use ?
6. If so, give particulars of treatment.
7. Is the pump to work alone or deliver into a common pressure pipe ?
8. If the latter, give full particulars of the other pumps.
9. Is the boiler fitted with an automatic feed regulator ?
10. If so, give particulars of the pattern used.
11. How is the pump to be driven ?
12. If by electric motor, state system, voltage and frequency of available supply.
13. If by steam-engine or turbine, state steam pressure at engine stop valve in lb. per sq. in. abs., and steam temperature in ° F.
14. Is the engine or turbine to work condensing or non-condensing ?
15. If the former, state vacuum obtained at exhaust flange of engine or turbine.

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1. For how long is maximum demand to last in hours, and are frequent variations in quantity of water pumped, or in pressure, likely to occur ?

4. The water may run to the pump under a gravity head. This should always be the case when hot feed is being pumped. The suction lift given should include the head due to pipe resistance when handling the maximum quantity of water.

6. If not, give source of water and hardness factor.

8. This should give the output of each pump, type of prime mover used to drive pump, size of pipe into which the pumps deliver.

13. Does pump receive steam from an independent source or from the same boiler that it feeds ?

16. If the latter, state back pressure in lb. per sq. in. abs. at exhaust flange.
17. Is the feed water to be heated by the exhaust steam from the engine or turbine ?
18. What accessories are required ?
19. Give dimensioned sketch showing proposed layout of plant.

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16. The pump may exhaust to atmosphere or into a feed-water heater. If the back pressure cannot be accurately given, the type, size, and make of feed-water heater, together with a detailed sketch of the pipe line, should be given.

18. This should indicate whether piping, non-return valve, sluice valve, water meter, pressure, and vacuum gauges, etc., are required.

19. The sketch should be dimensioned, and should show the position of the boiler feed pump relative to the boiler, feed heater, and hot-well, as well as the lengths and diameters of all pipes and the number of bends in each run.

## PUMP, LIQUID

1. State quantity of liquid to be pumped in gal. per minute. Normal..................Maximum................
2. Is the quantity of liquid pumped to be varied ? If so, how often, for how long, and between what limits?
3. Is the pressure of the liquid pumped to be varied ? If so, how often, for how long, and between what limits ?
4. What is the maximum temperature of the liquid in ° F. ?
5. What is the quality of the liquid ?
6. What is the maximum total suction lift from lowest water level to centre of pump in feet ?
7. What is the maximum total delivery lift from centre of pump to highest point of discharge in feet ?
8. What type of pump is desired ?
9. Is continuous or intermittent service required ?

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2–3. Such conditions are frequently required in large pumping stations. If possible, a chart showing the hourly or daily variations of the output from the pump should be included with the inquiry.

5. The quality of the liquid should be completely specified. This will include its condition, whether clean, gritty, or with solids in suspension. In the last instance, the size of the largest solid likely to come through should be given. If the liquid is corrosive, the nature of the acid or alkali and its approximate strength should be stated. If a salt solution is being handled, a chemical analysis should be given. If a liquid other than water (oil, spirits, acid, etc.) is to be pumped, its specific gravity and viscosity at the temperature stated under (2) should be included in the data given to this question.

6. This includes lift and friction head. If there is any variation in the level of the liquid in the suction sump, the maximum variation in feet should be stated.

7. This includes total lift and friction head. If there is any variation in the level of the liquid at the discharge, the maximum variation in feet should be given. It should be stated, when there is any variation in the suction and discharge water-levels, whether the variations occur together or at separate times, so that the maximum total overall lift may be accurately calculated.

If the pump delivers into a main pipe line common to other pumps, full particulars of the piping, length, variation in diameter, and size and type of each pump, together with the number delivering into the pipe at the same time, and the quantity of liquid each is delivering, should be stated. If the pump is to discharge into closed vessels, such as in bleaching plants, hydraulic accumulators, etc., the maximum pressure in lb. per sq. in. g. in such vessels should be stated in addition to the lift.

8. State whether centrifugal, turbine or ram, horizontal, inclined or vertical, submersible.

10. How is the pump to be driven ?
11. Does pump start with valve open or closed ?
12. Is the pump to be started automatically or by hand ?
13. How is the automatic starter to be operated ?
14. Is a compressed air or vacuum pumping plant desired ? State which.
15. What accessories are required with pump ?
16. Give dimensioned sketch of proposed layout.
17. State for what purpose the pump is to be used.

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10. State what type of prime mover is desired. Where the prime mover is to be supplied by the pump maker, send in a completed data sheet, for the type of prime mover desired, containing answers to all questions applicable to the case in question. If the pump maker is not to supply the prime mover, is a combined bedplate to take the latter to be supplied with the pump ? If so, the height of the centre of the prime mover shaft from the underside of its sole plate (in ft.) and type of coupling to be used, solid (if so, is half coupling to be supplied by pump maker), flexible, etc., should be given.

11. When the motor is to be obtained from a different manufacturer to the pump maker, it is necessary to know the starting torque required. This will depend on whether the pump is started with the valve open or closed, and should be given by the pump manufacturer as a percentage of the normal running torque.

13. This can be done by floats, ropes, and counterweights, or by difference in pressure through pressure switches or contact switches. In such cases, a sketch should be given to show the amount of movement provided by the float or the range of pressure available to operate the constant switches. Is the starting and stopping to occur at highest and lowest water-level in suction sump, or at lowest and highest water-level in reservoir ?

14. These systems are very useful for pumping corrosive liquid, sewage, etc. Is a supply of compressed air available ? State quality available, in cub. ft., of free air per min., and pressure in lb. per sq. in. abs. If not, is steam supply available ? State steam pressure in lb. per sq. in. abs., and steam temp. in °F.

15. The following accessories may be included: charging gear, foot valve, strainer, non-return valve, etc. If a centrifugal pump is to stand idle for any length of time the foot valve will probably not remain tight and, consequently, the suction pipes will slowly empty. In this case a charging set should be provided.

16. The sketch should be a detailed one, showing the length, diameter of piping, and number of bends, valves, etc., in each run. Full particulars should be given to enable friction head to be calculated. In the case of condensing plant, friction head of the condenser should be stated.

In the case of mine pumps, particular attention should be drawn to any limitations in the size of the pump due to size of cage or maximum weight it can carry, size of the underground roads or bad bends in them along which the pump has to be taken. A sketch of the underground pump room should be given to show space available. In the case of a dock pumping scheme, submit dimensioned drawing of dock, and show position of pump relative to it.

17. Waterworks, docks, sand dredging, chemical works, bleaching works (state process used), sewage, salvage, circulating pumps for condenser, hydraulic, drainage, etc.

## PUMP, VACUUM

1. What is the required capacity of the pump in cub. ft. of free gas per minute ?
2. What is the vacuum in inches of mercury desired to be maintained in the vessel to be exhausted when the pump is handling the above quantity of gas ?
3. Give full particulars of the gas to be handled.
4. What is the gas temperature at pump inlet in ° F. ?
5. Will the gas contain dust ? If so, state quantity of dust present in grains per cub. ft.
6. Against what pressure is the pump to discharge in lb. per sq. in. abs. ?
7. In what time must this vacuum be obtained, in minutes ?
8. Give particulars of vessel to be evacuated.
9. What type of pump is desired ?
10. How is the pump to be driven ?
11. Give dimensioned sketch of space available.

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3. This should state name, if a mixture give chemical analysis, and state density at 14·7 lb. per sq. in. abs. pressure and 60° F.

6. If the pump is not operating at sea-level, give the altitude at which the pump will be erected in addition to the discharge pressure.

7. Need not be answered when the vacuum is to be maintained continuously, as in case of turbine vacuum pumps, etc.

8. Volume in cub. ft., length, and diameter of connecting pipes.

9. Wet or dry pump ; reciprocating piston or rotary impellors.

10. Whether from existing shafting, in which case state speed in r.p.m. and size of available pulley, by steam engine, turbine or electric motor, in which case supply data sheet for the type desired.

## PURIFIER, WATER

1. State quantity of water to be purified, in gallons. Average per hour.......... Maximum per hour ..... Average per 24 hours . .
2. What is the temperature of the water at the purifier inlet ° F. ? Minimum . Maximum..... . Average...... . .
3. Give source of supply of the water.
4. State the nature of the impurities to be removed.
5. Has the water a marked taste or odour ? If so, describe as clearly as possible.
6. Is the water known to be contaminated with sewage ?
7. Does the turbidity of the water vary greatly with the rainfall ?

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1. If it is not possible to state the amount of water required, the purpose for which the water is required, the total number of inhabitants in the town to be supplied, or the number of persons in the institution, should be given. Should the quantity of water required vary much during an hour, the maximum and minimum during the hour should be given and, when possible, a chart showing the variation over 24 hours, included with inquiry.

3. This should state where the water is obtained ; whether river, lake, spring, well, etc.

4–6. The impurities to be removed may be divided up into—

(*a*) Suspended matter.
(*b*) Dissolved salts.
(*c*) Iron or manganese in solution
(*d*) Acidity or alkalinity.
(*e*) Colour.
(*f*) Odour.
(*g*) Bacteria.

In describing the water, it should be stated whether the suspended matter settles out rapidly on standing or, if the water still remains opaque after some hours. If it is possible to make experiment, state at what depth below the surface a wire, 1 mm. diameter, just becomes invisible. If the suspended matter settles, is the deposit white or coloured, and what is its nature ? Is the precipitation and clearing accelerated by adding aluminium sulphate ? If the water is clear and sparkling or dull, this fact should be noted. The permanent and temporary hardness should be given. Does the water contain any free gas, such as oxygen, sulphide of hydrogen, carbonic acid gas, methane, ammonia, etc. When such are present the amount should be expressed as so many milligrammes per litre of water. Wherever possible, a chemical analysis and a bacteriological report of the water should be sent with the inquiry. The bacteriological report should be complete and should state the total number of germs of all kinds per cub. cm., and also the presence or absence

8. Is the water to be sterilized as well as purified ?
9. Is any system of pre-purification employed ? If so, give description of the process and the plant used.
10. Is a gravity or pressure system of filtration most suitable for the existing conditions.
11. Will the purified water be discharged into tanks or direct into the mains ?
12. Does the water flow or must it be pumped to the filters ?
13. In the former case, what is the available head at the filter inlet in feet ?
14. In the latter case, give the total head against which the filters will work in feet.
15. If pumps are necessary, give particulars of the power available for driving them.
16. Is water for cleaning the filters available ? If so, state head in feet.
17. Is a live steam supply available ? If so, state steam pressure in lb. per sq. in.
18. Give dimensioned sketch of proposed layout.

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of disease-producing germs. Failing an analysis and report, an average sample of the water containing at least 1 gal. should be sent.

9. The description should include the size and amount of filter surface in sq. ft., the nature and the quantity of chemicals added per cub. ft. Also details of the layout showing the sizes of pipes, pumps, reservoirs, tanks, etc., should be shown on the detailed sketch asked for in question 18. Give total heads in ft. against which the existing pumps work, and state whether there is any spare power available and, if so, how much in h.p.

13. This is the total head less friction head in pipes, valves, etc.

14. This should include total lift plus total friction head in pipes, valves, etc., but excluding the filter.

15. If existing power is available, the amount available for extensions should be given. If the power plant must be extended, state what type of prime mover is required, and give necessary particulars of the supply available for it.

18. The plan should contain full particulars of any existing buildings which are to be used, with the necessary dimensions from which the available space for plant, and the heads against which the pumps must work can be obtained.

## PUSHER, INGOT

1. State maximum number of ingots to be handled.
2. Give full particulars of the ingot to be handled.
3. State total stroke required in feet.
4. Give dimensions of charging door. Width.. .. Height.. ... .. ... ....
5. Is charging door to be automatically opened by pusher ?
6. Are water-cooled sliding rails employed in the furnace ?
7. How is pusher to be driven ?
8. Is a travelling pusher required ?
9. Enclose dimensioned sketch of reheating furnace with which pusher will be used.

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See also data sheet for reheating furnace.

1. May be used for ingots, blooms, or billets. This should refer to ingot, etc., details of which are given in answer to question 2.
2. Dimensions and weight in lb. of largest piece to be handled.
3. The pusher should be capable of a stroke equal to full length of furnace, so as to be able to empty latter. If space does not permit of this, state exact stroke required.
7. Hydraulically, by steam, or by electric motor. State hydraulic pressure in lb. per sq. in. g. ; steam pressure in lb. per sq. in. abs., and steam temperature in ° F. ; or system, voltage, and frequency of supply.
8. This can be arranged if the pusher is to serve more than one furnace.
9. Sketch should show proposed position of charger.

# PYROMETER

1. Give range of temperature to be measured in ° C.
2. State type of pyrometer preferred.
3. Is an indicating or recording instrument required ?
4. If indicating instrument is required, state of what class.
5. What accuracy is required in the readings ?
6. What is the nature of the work in which the pyrometer will be used ?
7. Give a dimensioned sketch of the furnace into which the pyrometer will be built.
8. State the number of points at which the temperature is to be measured.
9. Is electricity available to drive the recorder ?
10. Give the length of the leads required in feet.
11. Will these leads be exposed to great heat or weather conditions ?
12. State size of hot body whose temperature is to be measured.

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1. State temperature in ° F., if this scale is desired instead of centigrade scale.

2. Thermo-electric pyrometers are suitable for temperatures between : minus 200° C., and plus 1,600° C.

Resistance pyrometers are suitable for temperatures up to 1,000° C.

Radiation pyrometers are suitable for temperature up to 2,000° C.

3. State also whether fixed or portable type is desired.

4. Whether edgewise, flat, or circular scale.

5. Express as plus or minus.. .. .° C.

6. It should be stated whether the pyrometer will be used, under pressure, in molten metals or in corrosive fluids. When used in vessels under pressure, state pressure in lb. per sq. in. abs.

7. Particularly showing the thickness of the wall into which the pyrometer is to be built.

9. If so, state system, voltage, and frequency.

10. Or give the distance in feet between the positions of the pyrometer and the instrument. Some patterns of recording instruments can be used to register more than one temperature at a time, for example, flue gas temperature and boiler feed water temperature. If such an instrument is desired, particulars as asked for above must be given for each temperature.

12–15. Apply only to radiation pyrometers.

12. Size of smallest piece visible should be given in inches.

13. Is this body in the furnace or in the open ?
14. May an opening be made in the furnace wall ?
15. If existing opening may be used, state size, in inches.

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13. In the former case, it will be assumed that body is to be in furnace only for a short time and that its temperature and not furnace temperature is in this case important. In latter case, what are the surroundings of the hot body, and how near to it may the pyrometer tube be brought ?

14. This will be left open whilst making reading. If smoke and fumes are liable to issue by this opening and obscure furnace, mention this fact.

## REACTANCE, POWER

1. State system, voltage and frequency of supply.
2. Where will the reactance coil be connected ?
3. What type of reactance coil is desired ?
4. Give particulars of all generators connected to the busbars.
5. Give particulars of all transformers in station.
6. Give particulars of all outgoing lines.
7. Send diagram of connections for the station.
8. If the station is not yet fully developed, give the fullest particulars possible of the proposed future additions to the plant.

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1. Voltage is outgoing line voltage.

2. Immediately before generator, between generator and transformer, before outgoing line, etc.

3. With iron core or non-magnetic core.

4. Following data are required—

(*a*) Voltage.

(*b*) kVA. output.

(*c*) Overload capacity.

(*d*) $\sqrt{\frac{L}{C}}$ for the generator, to be given by the makers.

(*e*) Are damping windings provided ? Or has the generator solid pole shoes or, in case of solid rotor type field, are brass wedges used ?

5. Same as for (4), except that (*e*) may be omitted.

6. Following data are required—

(*a*) Whether cable or overhead transmission.

(*b*) Voltage on line.

(*c*) kVA. carried by line.

(*d*) Self-induction of 1 mile of the line in milli-henries.

(*e*) Capacity of 1 mile of the line in micro-farads.

In the case of cables, (*d*) and (*e*) can usually be obtained from the cable makers. If (*d*) and (*e*) cannot be given for an overhead transmission line, then give the following data—

(*a*) Diameter of wire in inches or standard size.

(*b*) Distance of the wires from one another in inches.

(*c*) Are the conductors symmetrically arranged ? A small dimensioned sketch, showing arrangement of conductors on transmission mast, should be sent.

(*d*) Are conductors solid or stranded ?

(*e*) Is an overhead earth wire used ?

(*f*) Give the height of the wire above the earth or from overhead earthed wire, in inches.

7. This should show sizes of connecting mains, type of main used (cable or bare copper bar), distance between bars, etc., and distance between each piece of apparatus, i.e. generator, transformer, etc.

9. State maximum value to which the current must be limited.
10. State value of current up to which the reactance must have a straight line characteristic.

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9. Express as a percentage of the full-load value.

## RECORDER, WATER

1. State minimum level to be recorded.
2. State difference in level to be recorded. Maximum
   Average.
3. Do variations in water-level take place very rapidly, or with considerable turbulence ?
4. Is chart to be for daily or weekly periods ?
5. State sub-divisions required on scale.
6. Where will the apparatus be used ?
7. Enclose dimensioned sketch of apparatus in which recorder will be used.

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This data sheet can also be used for V-notch recorder, or for water-level indicator.

1. This fixes the datum line.
3. If water becomes very turbulent this is liable to affect accuracy of readings, and the float should then be protected with a pipe.
5. Cusecs, cub. ft. per minute. Or if preferred, can also read direct in inches, feet, etc.
6. Indoors or outdoors, exposed to weather.
7. This should be a sectional drawing of the river, flume, channel, etc., plans and elevations of tank, reservoir, well, etc., showing place where water flows away, shape and section of orifice ; in all cases show where recorder is to be erected.

## RECTIFIER, MERCURY ARC

1. Give particulars of the A.C. system on which the rectifier is to be used.
2. Give continuous current output required in kW.
3. Give continuous current voltage required.
4. What overload will the rectifier have to carry ?
5. What is the minimum load likely to be on the rectifier ?
6. What voltage regulation is required ?
7. Is remote control of the rectifier desired ?
8. Give particulars of the nature of the load on the rectifier.
9. What type of rectifier is preferred ?
10. Give particulars of water supply available for cooling.
11. Is a separate recooler for this water to be supplied ?
12. Is the rectifier to operate in parallel with other apparatus ? Give full particulars of this apparatus.

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1. Single-, two- or three-phase voltage, if voltage is variable state ± per cent, and frequency.

4–5. To be expressed as a percentage of the normal full load given in question 2.

6. A normal rectifier has a pressure drop of ca. 12 per cent from light load to full load. If closer regulation is required, the use of a cathode reactance coil will reduce the above figure to ca. 5 per cent. If still closer regulation than this is desired, ± 5 per cent can be obtained by tappings on the transformer and the use of a suitable switch. If constant voltage at all loads is required use an induction regulator.

7. Such, for instance, as the remote control from the main station of a rectifier in a sub-station.

8. Lighting, power, traction, welding, etc.

9. Glass or iron body. There is usually not much choice, glass being suitable up to ca. 100 amp., and iron having to be used above this.

10. State source, quantity in gallons per hour and pressure in inches w.g.

11. A recooler should be used when the rectifier supplies a traction load, or the system has one pole earthed, or D.C. voltage is above 600 V.

12. Type of apparatus, whether motor generator set, rotary converter or another rectifier should be stated. Also state maker's name, output in kW., and voltage regulation from no load to full load, for each set working in parallel. In the case of rectifiers it is possible, under certain conditions, to run more than one rectfier from the same vacuum pump and ignition set.

13. Is one pole of the D.C. system earthed ?
14. Is the rectifier to supply a D.C. three-wire system ?
15. Give dimensioned sketch showing space available for layout.

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14. If so, it is preferable to design rectifier to work across outers rather than use two rectifiers. In this case the out-of-balance current can usually be supplied by other sets with which the rectifier works in parallel.

## REGULATOR, FEED WATER

1. State quantity of feed water which will be passing through the regulator in lb. per hour.
2. What is the steam pressure in lb. per sq. in. abs. ?
3. What is the water temperature at inlet to regulator in ° F. ?
4. With what type of boiler is it to be used ?
5. Where is it to be erected ?
6. State size of delivery feed pipe in which it will be fixed.
7. How is water fed to boiler at present ?

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This data sheet can also be used for regulators on an hydraulic supply, in which case question 2 should give hydraulic pressure.

4. Lancashire, marine, Babcock & Wilcox, Stirling, etc.
5. On boiler or on wall.
7. Give particulars of pump or injector used.

## REGULATOR, INDUCTION

1. State system, voltage and frequency of supply to which it will be connected.
2. State maximum current flowing in the lines in which the regulator will be connected.
3. Give the amount of voltage regulation required.
4. With what class of apparatus will the regulator be used ?
5. Is it important that there should be no alteration in the phase relations of the primary circuit ?
6. How is regulator to be operated ?
7. Is it necessary to cut the regulator out of circuit whilst the circuit is still in use ?
8. Is any temperature rise specified ?
9. Enclose dimensioned sketch showing space available and proposed layout.

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3. State as plus or minus . per cent of main voltage.

4. Rotary converter (can be arranged built on to machine if this is desired), mercury arc rectifier, feeder, etc.

5. This may occur in the case of ring mains to prevent the production of out-of-balanced currents, or facilitate parallel operation.

6. Hand or electrically. In latter case, state whether by push buttons or by means of a voltage relay.

7. This necessitates special switching arrangements so as not to break the circuit.

## REGULATOR, SHUNT

1. What type of regulator is required ?
2. Give particulars of the generator with which it is to be used.
3. Is the machine self- or separately-excited ?
4. With what class of machine will the regulator be employed ?
5. State the resistance of the shunt field circuit cold, in ohms.
6. State the current which must flow in the cold magnet coils, when the machine is running at normal full-load speed, to produce—
   (*a*) Normal full-load voltage at no load.
   (*b*) Normal full-load voltage at full load.
   (*c*) Normal voltage required at the commencement of charge.
   (*d*) Normal voltage required at the end of charge.
   (*e*) Minimum voltage required.
   (*f*) Maximum voltage required.
7. In the case of alternators, is the regulator to be connected in the alternator field circuit or in the exciter field circuit ?

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1. Open, enclosed, wall, pedestal, or switchboard mounting, state whether front or back of board, etc.

2. Type, whether shunt or compound, kW. output, normal full-load voltage of hot machine. In case of machines giving a varying voltage, give maximum and minimum voltages required.

3. In the case of separately excited machines, state voltage available for the field circuit.

4. (*a*) Continuous current machine to maintain constant terminal voltage.
(*b*) Continuous current machine to maintain constant voltage at a given point.
(*c*) Accumulator charging machines.
(*d*) Booster.
(*e*) A.C. generator.

6. (*a*) and (*b*) apply to machines types 4 (*a*) and (*b*).
(*c*) and (*d*) apply to machines type 4 (*c*).
(*e*) and (*f*) apply to machines type 4 (*d*).

Whenever possible, enclose no load characteristic of cold machine, and full-load characteristic of hot machine.

8. In the former case, state maximum and minimum currents required to flow in the alternator field circuit and the constant exciter voltage available.
9. In the latter case, state maximum and minimum currents required to flow in the exciter field circuit and the voltages of the exciter corresponding to these currents.
10. Is hand or electrical operation desired ?
11. State system, voltage and frequency of supply available for electrical operation.
12. Are several regulators to be simultaneously operated by electrical gear ?
13. Is automatic voltage regulation employed ?
14. How is the regulator to be operated ?

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11. This should state particulars of any low voltage supply available in the case of high-tension machines.
13. State system employed.
14. Hand-wheel direct, hand-wheel through chain, etc. It is advsiable to enclose a sketch showing the proposed layout, when the regulator is to be operated other than direct.

If the inquiry is sent to the maker of the generator, the machine type and number should be given, to enable records of the machine to be consulted.

## REGULATOR, TEMPERATURE, AUTOMATIC

1. State temperature it is required to maintain constant in ° F.
2. Give limits within which it must be held.
3. With what class of apparatus will it be used ?
4. Indicate on plan where regulator may be built into apparatus.
5. If apparatus is under pressure, state internal pressure in lb. per sq. in. abs.
6. Through what medium is the regulator to operate ?
7. State pressure of the medium in lb. per sq. in. abs.
8. Does this pressure vary ? If so, between what limits ?
9. Enclose dimensioned sketch of proposed layout.

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3. Cookers, washers, dye vats, chemical vats.
6. Steam, air, water.
7. And in case of steam, state temperature in ° F.

## REGULATOR, VOLTAGE, AUTOMATIC

1. State system, voltage, and frequency of the alternators to be controlled.
2. How many alternators are to be controlled ?
3. State output of each alternator in kW. at definite P.F.
4. State speed of each alternator in r.p.m.
5. State maker and type of each alternator.
6. State prime mover used to drive each alternator.
7. If water turbines are used, describe method of speed regulation employed.
8. Do the alternators run in parallel or on separate bus-bars ?
9. What is the nature of the load on each alternator ?
10. Between what limits does the speed of each alternator usually vary ?
11. What is the percentage variation in the speed of each alternator when full load is suddenly thrown on—
    (*a*) Momentarily . .
    (*b*) Permanently.. . ......... ?
12. At what point of the system is the voltage to be held constant ?

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1. If there is any considerable variation in voltage, its amount and cause should be stated.

6. State whether the prime mover driving the alternator is a steam or water turbine, steam, gas, or oil engine.

8. When the alternators are running in parallel a single combined regulator must be used, whereas if they are connected to separate bus-bars, each alternator requires a separate regulator. In order to obtain good parallel working it is necessary that the characteristics should be similar and the time constants the same for both alternators and exciters. These conditions are naturally best obtained when the machines are of the same size and make.

9. State whether traction, power, lighting, electrolytic, etc.

12. The voltage may be maintained constant at the station bus-bars or at some distributing point. State which is desired. In order to maintain a constant pressure at the distributing points it is necessary to raise the voltage of the generator as the load increases, to compensate for the drop in the feeders. This may be obtained automatically to the extent of ca. 15 per cent, by the aid of a current transformer connected in the outgoing feeder. If there are several feeders the transformer should be connected in that one carrying the maximum lighting load.

13. At what figure is this voltage to be kept constant ?
14. If the pressure at a distributing point is to be maintained constant, is a current transformer to be supplied with the regulator ?
15. If so, what is the maximum current in the feeder to this point ?
16. What is the amount of overcompounding required with the maximum current flowing ?
17. Is it desired to alter by hand the voltage to be maintained constant ?
18. If so, to what extent ?
19. How many exciters are to be controlled ?
20. State speed in r.p.m., voltage, and output in kW., for each exciter.
21. State maker of each exciter.
22. State type of each exciter.
23. How is each exciter driven ?
24. Have exciters solid or laminated poles ?
25. Do the exciters work singly ? If so, with which alternators ?
26. If exciters work in parallel, how many are required at maximum load ?
27. Are automatic regulators already installed, and if so, on what system ?
28. State where regulator is to be erected.
29. State voltage and shunt current of each exciter under the following conditions—
 (*a*) With the main alternator field regulating

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17. Hand regulation is not usually required when a current transformer is employed, but can be provided in the latter case if a small series resistance is used. The alteration allowable by this method is plus or minus $7\frac{1}{2}$ per cent.
18. State, as a percentage of normal, no load terminal voltage.
23. State whether direct-coupled to alternator, motor or engine-driven, belt, rope drive, etc.
28. Are they to be fixed on main switchboard, or at some other point in the station ?
29. The voltage required in answer to (*a*) must be taken when the machine

resistance short-circuited and the alternator running on no load with normal terminal voltage and normal speed.

(*b*) With the main field regulating resistance short-circuited and the alternator running on full load with normal terminal voltage and normal speed.

(*c*) As for (*b*) but with voltage increased to compensate for drop in the mains.

(*d*) With short-circuited exciter shunt regulating resistance.

30. What is the shunt current for each exciter when exciter voltage is 15 per cent in excess of that required when the alternator is maintaining normal terminal voltage on full load ?

31. What is the main field current when the alternator is running at normal speed, giving normal voltage, at no load and at full load respectively ?

32. Have the shunt regulators sufficient resistance to regulate the exciter voltage down to 35 per cent of that given in answer to question 29 (*a*) ?

33. Under the conditions specified in question 32, are the shunt resistances of sufficient capacity to carry continuously half the shunt current given under question 29 (*b*) ?

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is cold, that under (*b*) when the machine is hot. Further, when taking these voltages the speed of the machines should be normal, but the slight variation in (*a*) when the load is thrown off and in (*b*) when it is thrown on, should be noted. The exciter must be capable of giving a voltage 25 per cent above that given in answer to question 29 (*c*), when the alternator is delivering maximum load with the exciter shunt regulating resistance short-circuited and the regulator in circuit. The maximum exciter voltage given to question 29 (*c*) should not exceed two and a half times the minimum given to question 29 (*a*).

## RELAY, ELECTRIC

1. What type of relay is required ?
2. With what class of apparatus will it be used ?
3. Is a combined relay desired ?
4. Give particulars of the system which the relay is to protect.
5. State normal full-load current in the circuit.
6. Give limits between which relay is to act.
7. Is a L.T. supply available for tripping circuit ? Give particulars.
8. Is an instantaneous or time limit relay desired ?
9. Is the time limit relay to have fixed or inverse time limit ?
10. Is the relay to close or open tripping contacts ?
11. Is relay to be fitted with indicator ?
12. Will an existing transformer or shunt be used ?
13. What style of finish is required ?

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1. Overload, reverse current, reverse power, no voltage relay, plain make or break relay, overspeed relay, voltage relay.

2. Switches, out-of-balance control, protective gear for generators, transformers or feeders, battery switches, etc.

3. Overload and reverse power protection can be combined.

4. System, D.C., single- two-, or three-phase, three- or four-wire. With or without earthed neutral. Unless excluded by question 12, transformers (enclose completed data sheet) or shunts should be asked for in all cases where they appear necessary.

6. Can be expressed as a percentage of the value given in answer to question 5.

9. With fixed time limit relays the time required to trip switch remains the same for all overloads, whereas with inverse time limit relays the tripping time varies inversely as the overload.

11. Can be used for tell-tale relays to indicate what apparatus circuit, etc., requires attention, not usually employed on tripping relays.

12. In case of shunt, state voltage drop across its terminals. In the case of a transformer, state for what secondary voltage it is wound, its volt-amp., rating, and volt-amp. demand of all instruments, etc., already connected to it.

13. For separate mounting or on switchboard. In latter case, state whether for surface or flush mounting.

State whether black enamelled all over, nickel all over, black enamelled with nickel facings, etc.

## REMOVER, SCALE

1. State clear diameter of tube to be scaled, in inches.
2. State thickness of scale to be removed, in inches.
3. Give length of tube to be scaled, in feet.
4. For what purpose is tube used ?
5. How is scaler to be driven ?
6. In case of water mains, enclose dimensioned sketch of main.

---

This data sheet may be used for scaling tool for cleaning boiler tubes, economizer tubes, heater tubes, etc., also for pipe cleaner and scraper for water mains.

1. Tube or pipe as is most applicable.
4. Boiler, economizer, heater, water main, etc.
5. By hand, by water or air pressure, state pressure in lb. per sq. in. g., by steam pressure, state pressure in lb. per sq. in. abs., and temperature in ° F.; by electric motor, state system, voltage and frequency.
6. This should show position of all valves, etc.

## RIVETER, PLATE

1. For what class of work is the riveter required ?
2. State depth of throat required from snap to back of the machine in feet.
3. Give size of rivet to be used in inches.
4. State what medium is to be used for operating the riveter.
5. State pressure of the medium available in lb. per sq. in. g.
6. In what form is the riveter to be supplied ?
7. What size of riveter is required ?

---

1. General steel constructional work, ship's plates, boiler, etc.
3. State maximum and minimum sizes to be handled.
4. Hydraulic or pneumatic.
6. For suspension from above or fixing on floor.
7. Usually given by the pressure to be exerted in tons, but this is also fixed by size of work and size of rivet used. As a check on the above data, therefore, it is useful to state maximum length, breadth, and thickness of the plates to be handled.

## ROLLS, LIVE

1. State maximum weight of billet to be carried, in tons.
2. Give dimensions of billet to be handled.
3. Give dimensions of finished work after passing through rolling mill.
4. State speed with which the billet is to be fed forward in feet per minute.
5. State output required from mill, in tons per hour.
6. Are reversible rolls required ?
7. State total length of track required, in feet.
8. State width of track required, in feet.
9. With what class of machines are the rolls to be used ?
10. How are rolls to be driven ?
11. Enclose dimensioned drawing of live rolls.

---

1. Can be used for blooms, ingots, billets, bars, etc.

2. (*a*) Of largest billet. (*b*) Of smallest billet to be handled. This will to some extent fix the distance between centres of the rolls. If a minimum width is prescribed, state figure in inquiry.

3. As for (2).

4. If this speed is to be variable, state range required.

9. Rolling mill, state whether bar, bloom, ingot, plate, rail mill, etc., transporting rolls, rolls to saws or shears, etc.

10. By bevel gearing, brake and crankshafts or rope. Choice is more or less fixed by work. By steam-engine or electric motor. In former case, state quantity of steam available in lb. per hour, pressure in lb. per sq. in., and temperature in ° F., and whether to exhaust to atmosphere or against a back-pressure, in latter case state back-pressure. For electricity, state system, voltage and frequency. Enclose data sheet for motor and controller.

11. Should show relation of rolls to mill, position of drive and method of gearing up each roll with prime mover.

## ROLLER, ROAD

1. What type of roller is required ?
2. State what size of roller is desired.
3. Give maximum gradient of the roads on which the roller will work.
4. Give particulars of the fuel to be used.
5. Is the roller also to be used as a haulage engine ?
6. Is the engine fly-wheel to be used for driving other machinery ?
7. Is the roller to be used with a road scarifier ? Give type preferred.
8. Is a winding drum to be provided ?
9. Are roller wheels to be fitted with water sprayers ?
10. State what accessories are to be included.

---

1. Petrol, paraffin or steam-engine ; in latter case state whether single-cylinder or compound engine is required.
2. Usually given as weight in tons.
4. Name, size, calorific value in B.Th.U. per lb.
5. This will necessitate extra gear.
6. State what class of machinery is to be driven. This usually means the addition of governing gear to the engine.
7. Is the scarifier to be part of the roller or independent type.
10. Tender awning (or awning over whole engine), water injector or pump, water hose, etc.

## ROPEWAY, AERIAL

1. Give the quantity of material to be transported per day, in tons. Maximum.... Minimum ....... Average.. . .
2. What is the load in tons per hour? Maximum . . . Average. . . .... .
3. Give a description of the material to be transported.
4. What size of bucket is preferred?
5. What is the length of the proposed line in yards?
6. Give a full description of the ground to be covered.
7. Can proposed ropeway be run in a direct straight line from terminal to terminal?
8. What is the difference in height between the terminals in feet?
9. Are there variations in the gradient along the line?
10. Is the mean grade in favour of or against the load?
11. Are loads to be carried both ways? If so, give answers to questions 1, 2 and 3 for the reverse load.
12. How is the material to be loaded and unloaded at the terminals?

---

2. If there is a considerable variation in the load, the maximum hourly load is important.

3. State nature of material, coal, clay, iron ore, timber, etc., weight per cub. ft. in lb., and dimensions of largest piece to be carried.

4. Does the nature of the work carried on necessitate that the individual bucket loads be kept to a particular weight? If not, the choice of the size of bucket should be left to the firm designing the ropeway.

5–6. The answers to these questions should be given in addition to the profile map. The answer to question 6 should state whether the land is subject to floods, or whether any rivers, swamps, forests, or difficult places generally, or roads, railways, etc., calling for special precautions, will have to be crossed. Their location and approximate width should be indicated on the map. Whenever possible, the direct route between terminal and terminal should be chosen.

9. Indicate length in yards, position of gradient and amount of gradient expressed as a percentage on the profile map.

12. An exact description of the manner in which the material will be fed into the buckets and the arrangements at the loading station for doing this should be given. At unloading stations, is the material to be tipped into railway wagons, trolleys, clay mills, crushers, etc., or dumped? Is automatic

13. Give a dimensioned sketch of the space available at the terminals for the loading and unloading arrangements.
14. Are intermediate loading and unloading stations required ?
15. If so, state type and give location on the line.
16. What type of drive is preferred ?
17. Is a weighing and counting machine required ?
18. Give a dimensioned profile map of the country over which the ropeway is to run, showing proposed run of ropeway, position and lengths of gradients, and location of intermediate loading and unloading stations.
19. Specify any regulations affecting the design of the ropeway.

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tipping and automatic return of tubs required ? Sketches of existing or proposed arrangements should be given whenever possible.

15. For type, see under question 12.

16. If power is available, state at which terminal. If the ropeway is run over level ground, or the load has to be delivered uphill or the gradient in favour of the load is not sufficient to overcome friction, then some form of drive will have to be provided. State whether steam, gas, oil engine, or electric drive is preferred. If a steam engine is desired, is steam available at either terminal, and what is the boiler pressure in lb. per sq. in. g., and temperature in ° F. ? If steam is not available, what fuel will be used under the boiler to be provided. Give quality, class, and calorific value. Is a plentiful supply of good clean water available for boiler feed purposes ? Give full particulars as to where this water is obtained and its hardness factor. Also any other peculiarities likely to detrimentally affect boiler operation. If a gas engine is to be used, state quality, class, and calorific value of the gas, and if oil engine, the class and calorific value of the oil to be employed. In the case of an electric drive, give system, voltage and frequency available.

18. This should show the complete length of the line, all gradients, their lengths and position, position of rivers, roads, swamps, etc., location of intermediate loading and unloading stations, angles or turns, etc. A profile map is very important in fixing the heights of the towers, and showing whether there is sufficient clearance on the spans.

19. Such as minimum distance between bucket and ground, special road or railway crossings, crossings under or over electric transmission lines, etc.

## RUNWAY

1. State maximum weight to be lifted, in pounds.
2. State maximum height the load is to be lifted, in feet.
3. Give maximum weight of material to be handled per hour in tons.
4. Give maximum length of run for maximum load, in feet.
5. Is the lifting tackle to be hand or electrically operated ?
6. Is carriage to be controlled from the floor or from a cage ?
7. Give particulars of the electric supply available.
8. Are the loads to be weighed or counted ?
9. Are automatic points to be provided ?
10. Is an automatic block system required ?
11. Enclose dimensioned sketch of the shop.

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This data sheet may also be used for mono-rail crane, but in this case also state radius of jib required in feet.

2. This should be measured from floor-level. If the runway also has to lift from a cellar, or lower from an upper story to ground, the length of this lift should be given separately and in addition to lift from floor.

7. System, voltage and frequency.

8. State which is required.

10. In this case, state whether rail is to be an endless system or whether a see-saw system of operation is required. In latter case, the mono-rail carriages can be automatically emptied and reversed at the end of the journey. State whether these features are required.

11. A plan showing proposed route of runway, including all crossings and branches, with collecting and discharging points, and position of gangways should be sent, together with an elevation showing size of all columns, girders, etc., which it is proposed to use to support the runway. It is assumed that the mono-rail will be level throughout. Should this not be the case, clearly specify gradient and its position.

## SCREEN, WATER

1. Give quantity of water to be screened in gal. per minute.
2. State purpose for which the water is required.
3. Give particulars of the source of supply.
4. What is the nature of the foreign matter to be screened ?
5. What is the depth of water available at the proposed site of the screen in feet ? Maximum .. Minimum ........ .
6. What is the head of water available at the screen, in feet ?
7. What type of screen is desired ?
8. How is screen to be driven ?
9. Give dimensioned sketch showing proposed arrangement of intake.

---

2. Whether for circulating water in power plant condensers, laundries, chemical works, etc.

3. Sea, river, canal, lake. If likely to contain injurious chemicals, give analysis with the inquiry.

4. Leaves, twigs, wood shavings, etc.

5. In the case of a sea screen, this should give the maximum and minimum tides occurring. In the case of a river, the average maximum over a number of years and not necessarily the maximum flood value.

6. The head of water required for satisfactorily operating the screen will depend to some extent on the type employed. Fresh water may also be required for cleaning the screen. State if available and head in feet.

7. Disc (for small variations in water-level), band (for tidal estuaries), rake (for very coarse material).

8. Screen is not always driven, it may also be of stationary type. If it is to be driven, is there a supply of water available (ca. 10 lb. per sq. in. pressure is required), or is transmission available, in which case state speed in r.p.m., size of pulley, and show its position on the sketch; or motor drive, in which case send data sheet for motor.

9. This should show position of screen with relation to intake and delivery of water, as well as any screening arrangements at present in use.

## SEARCHLIGHT, ELECTRIC

1. State the diameter of the area to be lit in feet and its distance from the searchlight in yards.
2. What intensity of illumination is required on the object in foot cdls. ?
3. At what distance from the searchlight in yards is the object still to be visible ?
4. What is the nature of the object to be viewed ?
5. Is diffused light required in addition to the concentrated direct beam ?
6. If so, what is the maximum vertical and horizontal divergence required in degrees ?
7. Is variation from nil to maximum divergence required ?
8. Is a ribbed glass disperser or a ground lens preferred ?
9. What is the maximum burning duration required, in hours ?
10. For what purpose will the searchlight be used ?
11. What form of support for the searchlight is desired ?
12. How is the searchlight to be operated ?
13. What special finish is required ?
14. State system, voltage and frequency of supply available.

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3. That is, at what distance is it desired to be just able to pick up an object but not to distinguish much detail ?

6. If the searchlight is to be for Suez canal work this should be stated.

7. Is the change from concentrated beam to maximum divergence to be gradual, or may it take place in one step ?

9. The average length of burning of a pair of carbons is ca. 4 hours.

10. For Navy, Army, merchant ships, lighthouses, signalling, etc.

11. Is searchlight to be stationary or movable, and in latter case is it to be on rollers, on a wagon or trolley, on slides or rails, or transportable ? If fixed, is the support to be a low pedestal, pillar, tripod, or turntable, spring suspension, etc. ?

12. Directly by hand, by hand with fine adjustment, by wire rope, by rods and levers, or electrically.

15. What accessories are required ?
16. Give dimensioned sketch showing position of searchlight in relation to source of supply.

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15. Is a metal or a parabolic glass mirror preferred ? Is an iris diaphragm or a signalling shutter to be included ? Is a sighting device necessary ? Is the horizontal scale to be divided into degrees, and is it to be illuminated ? How are the cables to be connected to lamp ; by plug, cable lugs, or taken directly into lamp ? Is a shunt or series lamp desired ?

## SEPARATOR, OIL

1. State the maximum amount of steam to be dealt with in lb. per hour.
2. Give the steam pressure in the separator in lb. per sq. in. abs.
3. State the diameter of the pipe in which the separator will be erected, in inches.
4. What type of separator is desired ?
5. State how the oil is to be drawn off from the separator.
6. Give voltage of the continuous current available for de-oiling.
7. Give a dimensioned sketch showing proposed site for de-oiler.

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2. This will depend on whether the separator is in the main exhaust or heating line.

4. This should state whether of cylindrical or rectangular form, and position of inlet and outlet flanges.

5. It should be stated whether an automatic discharge, a vacuum tank or a pump is preferred for extracting the oil from the separator. In the case of pump extraction, state what power is available for driving it, and give particulars of available supply.

6. For electrical separators, continuous current is necessary. If this is not available, state the nature of the supply which is, i.e. give system, voltage and frequency.

7. It is assumed that the condensate will flow to the de-oiler ; if this is not the case, give particulars on the sketch of the proposed arrangement.

1–5. Apply to mechanical separators dealing with oily steam, 6 and 7 need not be answered.

1, 6–7. Apply to electrical separators dealing with oily condensate, 2–5 need not be answered.

## SEPARATOR, ORE, MAGNETIC

1. State amount of material to be cleaned in lb. per hour.
2. Give particulars of the material to be cleaned.
3. Is material required for manufacturing purposes ?
4. State the conveyor belt speed in feet per minute.
5. State width of conveyor belt in inches.
6. State diameter and width of magnet pulley required in inches.
7. What is the voltage of supply available ?
8. Can the material be treated in a wet or semi-liquid condition ?

---

Alternating current is not suitable unless a special generator is to be supplied. in which case enclose a data sheet.

2. Name of material, iron sands, zinc blends, tin ore, clay, etc., average size, chemical analysis of the material, giving particularly the percentage of iron present and its character.

3. If separator is only used to stop iron getting into crushing or other machinery and to prevent damage, mention this fact.

## SEPARATOR, WATER

1. State the maximum amount of steam to be dealt with in lb. per hour.
2. Give the steam pressure in the separator in lb. per sq. in. abs.
3. State the diameter of the pipe in which the separator will be erected, in inches.
4. What type of separator is required ?
5. Is a water gauge to be provided ?
6. Is steam superheated or saturated ?

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4. This should also state the desired positions for the inlet and outlet flanges.

## SET, ELECTRIC LIGHTING

1. State type of set required.
2. State type of engine preferred.
3. Give particulars of the fuel to be used.
4. What method of engine cooling is preferred ?
5. Give particulars of cooling water available.
6. State average load on the generator in kW.
7. State what voltage is desired.
8. Is a battery to be provided ?
9. Is a switchboard to be provided ?
10. Enclose dimensioned sketch showing space available and proposed layout.

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1. Automatic, i.e. set starts up automatically on a predetermined load : semi-automatic or hand starting.

2. Oil or gas.

3. State source of gas. If no source of gas is available, is a gas producer plant to be offered ? Calorific value of fuel (i.e. oil, gas, or coal, as case may be) in B.Th.U. per lb. or cub. ft.

4. Motor-car type radiator, fan or water cooling from tanks.

5. Source, quantity in lb. per hour and average temperature in ° F. Need only be answered when a gas producer is offered.

6. If this cannot be done, state number, size, and type (vacuum, gas-filled, etc.) of all lamps in the house ; rating of all electric radiators used ; rating of any appliances used (toasters, kettles, irons, washers, etc.). (Appliances, etc., are usually rated in watts.)

9. State any desires as to type of instruments and their finish. State the number of sub-circuits in the house to be controlled, and whether any spare ways are to be left.

## SHUTTERS, ROLLING, STEEL

1. Give width and height of opening to be closed, in feet.
2. State clearance between top of opening and underside of ceiling, in feet.
3. State to what material the roller guides are to be attached.
4. Give details of lintels, plinths, bases to columns, etc.
5. Is there any projection on the inside wall near the proposed opening ?
6. If so, give the distance from the edge of the opening to the edge of the projection, in feet.
7. State from what point the shutter is to be operated.
8. If the floor is not level, give the difference in height between the two sides of the opening.
9. Give dimensioned sketch of wall in which opening will be.

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4. If the inside wall on which the shutter is to be fixed is not flush, the fullest particulars of all projections, such as plinths, braces, guards for edges, etc., or recesses should be given. The length and depth of the lintel and, if not straight, its curvature should also be stated. If the opening is framed by girders, the dimensions of each size of girder should be given. When the lintel girder is of a smaller size than the side girders, the distance from the inner face of the lintel girder to the inner edge of the side girder, measured on the inside of the opening, in inches, should be stated.

7. Right- or left-hand side, inside or outside.

## SOFTENER, WATER

1. State quantity of water to be softened in gallons; average per hour ...... maximum per hour average per 24 hours ... . ...
2. What is the temperature of the water at the softener inlet ° F.? Minimum . . . Maximum ....... .. ..Average...... .. . .
3. Give source of supply of the water.
4. State the nature of the impurities to be removed.
5. Is the water delivered to the softener under pressure? If so, state head in feet.
6. Is a feed tank available into which the purified water can gravitate? If so, give size.
7. For what purpose is the softened water to be used?
8. What degree of hardness is desired after treatment?
9. Is exhaust steam available for heating the crude water. If so, state quantity in lb. per hour.
10. Is a live steam supply available? If so, state steam pressure in lb. sq. in. abs. and steam temperature in ° F.

---

1. If this cannot be given accurately, the number, type and size of boilers on load, maximum and average steam consumption of the engines, turbines, etc., should be given.

3. This should state where the water is obtained, whether from river, lake, spring, canal, well (shallow or deep), town supply, etc.

4. This can best be done by giving a chemical analysis of the water together with following information—

(*a*) State whether impurities are suspended or dissolved.
(*b*) Give hardness factor of crude water.
(*c*) State if the crude water is acid or alkaline.

If such information is not available, at least a gallon of water, taken so as to represent a fair average sample, should be sent for analysis to the firm making the quotation.

6. If the water cannot gravitate to the tank, state the total head in feet against which it must be pumped.

9. If it is necessary to use steam for heating and exhaust steam is available, this must be free from oil. State, therefore, source from which the exhaust steam is obtained, and whether a suitable oil separator is placed before the softener.

10. Live steam may be used for heating water or may be necessary for raising the chemicals from the mixing mill to the measuring tank, or for working the air injector for sand cleaning purposes when this is used. As

11. Is power available for driving the mixing mill? If so, give particulars.
12. Is a source of wash water available for cleaning the filters? If so, give quantity in gal. per hour and pressure in lb. per sq. in. under which it is delivered.
13. Give dimensioned sketch showing proposed layout.
14. Is a "continuous blow-down" system required?
15. Is a "degassing" plant to be used with the softener?

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a general rule, sand filters will not be used for industrial work but only when water is for potable purposes.

11. The lime and soda mixer can be driven from a line shaft, but if this is not available other means will have to be used. If electric power is available, give system, voltage and frequency.

12. Instead of giving pressure in lb. per sq. in. g., it may be given as inches w.g.

13. The sketch should show the space available for the softener, and give all dimensions necessary to enable any head against which water must be pumped to be calculated.

14. This should preferably be used in conjunction with the soda treatment.

15. See data sheet on degassing plant.

## STARTER, MOTOR

1. What is the b.h.p. of the motor to be started ?
2. State system, voltage and frequency of the supply on which the motor is to be used.
3. What type of motor is the starter to be used with ?
4. What machine does the motor drive ?
5. Is the starter to be reversing ?
6. What type of starter is desired ?
7. Is the starter to be hand or automatically operated?
8. Against what torque is the motor to be started ?
9. What is the frequency of starting ?
10. In what time is the motor to be brought up to full speed ?
11. What tripping features are to be provided on the starter ?

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See B.S.S., Nos. 82, 117, 118, 123, 129, 140, 141, 147, 155, 167.

2. D.C., single-, two-phase, three- or four-wire; three-phase, three- or four-wire; is neutral point earthed ?

3. State whether shunt, series, or compound-wound D.C. motor, squirrel cage or slip-ring A.C. motor.

6. Liquid or metal, star-delta, auto-transformer, or resistance in stator (for squirrel cage motors), resistance in rotor for slip-ring motors. Ventilated or totally-enclosed resistances, air- or oil-cooled resistances, watertight, explosive-proof, air or oil break for contacts.

7. In the case of automatically-operated starters, state what type of control device is desired; push button; pressure switch, and whether for liquid or gases and pressure range; float switch for tanks, reservoirs, etc., master switch. In case of hand control, is starter to have hand lever or rope wheel ?

8. This may be stated as so many times full load torque.

9. A starter is not designed for frequent starting; if this is necessary a controller should be used. From the point of view of the heating of the starter resistances, two starts should not occur at lesser intervals than 15–30 minutes, depending on whether the resistance is ventilated or enclosed.

10. When starting the motor against full load torque, the usual starting period allowed is—

| | | |
|---|---|---|
| Up to | 20 h.p. | 40 seconds |
| ,, | 35 ,, | 50 ,, |
| ,, | 60 ,, | 60 ,, |
| ,, | 120 ,, | 70 ,, |
| ,, | 200 ,, | 80 ,, |
| ,, | 350 ,, | 100 ,, |
| ,, | 1,000 ,, | 120 ,, |

11. Starters may be fitted with—

(a) Overload release with or without time lag. State the maximum

12. Is speed regulation required ? Give range.
13. What is the current in the shunt field circuit of a D.C. motor at full load ?
14. What is the lowest voltage at which the motor will pick up load ?
15. What is the slip-ring voltage at standstill ?
16. What is the rotor current in amps. at full load ?
17. Is the rotor star, mesh, or L connected ?
18. Is the starter to be interlocked with the main switch ? If so, state whether electrically or mechanically.
19. Is the starter to be interlocked with the brush lifting and short-circuiting device ?
20. Is slow-motion starting gear desired ?
21. What type of fittings are to be provided ?

---

over-load setting required as a percentage of full load. Also state maximum amps. in field circuit.

(*b*) No volt release.

(*c*) Remote release.

(*d*) Leakage trip.

(*e*) Overspeed trip. Only used with D.C. series motors, in which case state maximum excess speed at which the trip is to act.

Releases and trips cannot be put on rotor starters when slip-ring short-circuiting device is used. In such cases they must be combined with the switch controlling the stator circuit. As a rule, releases and trips are not operative in the starting position, but only in the running position. Under certain conditions they can be put on the starting position, if specially required.

12. In case of D.C. machines, state whether field and armature regulation is required. Also state whether motor is to run for long periods at different speeds.

16. Also state rotor current at the torque under which the motor must start as given in question 5.

17. When possible, also state resistance of rotor winding.

19. This can be done when the starter is built on to the motor.

21. Cable lugs or terminals, standard bushings, conduit glands, or cable-end boxes. Is the starter to be built into a control panel ? If so, give dimensioned sketch showing space available.

Whenever possible, submit a data sheet for the motor with which the starter is to be used.

## STATION, CHARGING, ACCUMULATOR

1. State the capacity of the battery to be charged in amp. hours.
2. How many batteries are to be charged at the same time ?
3. What is the maximum permissible charging current in amps. ?
4. What is the working voltage of the battery ?
5. What type of battery is to be charged ?
6. State system, voltage and frequency of supply available.
7. How is voltage variation to be obtained ?
8. Is charging station to be on surface or underground ?
9. In latter case, is the situation damp and can efficient ventilation be provided ?
10. Enclose a dimensioned sketch of available site.

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See B.S.S., No. 74.

Battery here means a group of connected cells.

1. State rating of this capacity (usually 1-hour discharge) and maker's name.

2. That is number of groups.

3. Is not essential if question 1 is fully answered.

3–4. Is assumed that batteries are all of same size.

5. Lead or iron.

6. It is here assumed that electricity is available. If that is not so, state type of prime mover preferred for charging dynamo, or if a transmission is available, give speed in r.p.m. and size of pulley. Give particulars of any D.C. generator which could be used for charging. Type (shunt, compound, state with or without interpoles), output in kW., normal voltage, speed in r.p.m. Will any other load be on this generator, or can it be exclusively used for charging ?

10. This should show where locos will run into station. It may be assumed that batteries will be run off of the loco on to a charging table, and wiring will be carried out accordingly.

# STATION, GENERATING

1. State system, voltage and frequency preferred.
2. For what class of work is the station to supply current ?
3. Give the output required from the station in kW.
4. How is the prime mover to be driven ?
5. Give particulars of the fuel to be used.
6. Give particulars of the water supply available.
7. On what class of ground is the station to be built ?
8. Give particulars of the facilities available for the transport of coal to, and ash away from the station.

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1. This choice is not absolutely free. It depends on class of work done, on demands and distance of these demands from proposed site. The choice should be left to the estimator unless there are special reasons, such as an existing installation, which will fix these data.

2. Village lighting, coal mine, steel works, machine shop, etc. ; specify as clearly as possible exactly what is made, and give average annual output of the articles made, list of all machines and their sizes at present in use, number of shifts worked per day and length of each shift in hours. In case of village lighting scheme, state number of inhabitants taking current and average number and wattage of lamps for each house.

3. This is difficult to answer satisfactorily in all cases. When possible, state maximum demand likely to come on to the station and its duration in hours, average continuous demand over a shift, or send a representative daily load curve (kW. plotted against hours).

4. Steam engine, steam turbine, water turbine, oil engine, etc. The steam pressure and temperature will be chosen by estimator unless an existing supply is available or can be extended. State existing boiler pressure in lb. per sq. in. abs., and temperature in ° F. In the case of water turbines, give relevant particulars asked for on water turbine data sheet.

5. Class, coal, coke, wood, oil, etc. Calorific value in B.Th.U. per lb., size of fuel, chemical analysis.

6. State average minimum and maximum quantity available in gallons per hour, its quality, clean, gritty, etc., from what source obtained, river, pond, etc., its hardness.

7. Whether clay, gravel, chalk, etc., and depth in feet from surface to bed rock.

9. Each demand, whether for house lighting or a motor, and its size in kW., should be accurately given on a scale plan, so that the most economical site for the station may be chosen or, when this is fixed, the distances from the site may be measured. When the various loads are different, each demand should be carefully specified so that it is possible for the estimator to fix the total average and maximum demands on the station. Consequently, hours of use and average demand, as well as maximum demand, and time when this occurs, should be given for each demand.

9. Dimensioned plan showing position of each demand on the station and its amount in kW.
10. Ground plan to scale, showing proposed site.

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10. This should also show position of railway, river or other water supply, etc.

The inquiry should state exactly how much of station plant is to be offered, i.e. plant is to include all boilers, etc., engines and accessories, generators and accessories, switchboard and accessories, to exclude buildings, distribution mains, water pipes, etc., outside of station itself.

## STOKER, MECHANICAL

1. Give name of boiler, maker, and type and size of boiler with which the mechanical stoker is to be used.
2. State number of firing flues.
3. Give length and diameter of firing flues in feet.
4. Give grate surface in each flue in square feet.
5. State distance, in feet, from front of boiler to the bridge wall.
6. Give diameter of heating tubes in inches.
7. State length of the grate in feet.
8. Give width, in feet, between the furnace walls.
9. What is the height of the front header from floor level, in feet ?
10. What is the distance between the front boiler stanchions, in feet ?
11. Where is the superheater placed in the boiler, and what is its heating surface in square feet ?
12. What is the heating surface of the boiler, in square feet ?
13. State steam pressure in lb. per sq. in. abs., and steam temperature in ° F.
14. What is the weight of fuel to be burned per boiler per hour, in tons ? Average............. Maximum ....................

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1, 11–23. Apply to all boilers.
2–5. Apply to Lancashire type of boilers only.
6–10. Apply to water-tube boilers only.
7–8. In the case of externally fired boilers, a dimensioned sketch of the proposed or existing furnace chamber should be sent.
14–16. Refer to the fuel it is proposed to use with the mechanical stoker. If the boilers are in use and it is proposed to change the quality of the fuel when the stokers are fitted, the particulars asked for should be given for both the present quality and the quality it is proposed to use. In order to enable the comparative saving to be calculated, the cost per ton for both qualities should also be given.

15. What weight of fuel is burned under all boilers together at present moment, in tons? Average . ... Maximum . ... .
16. Give full particulars of the fuel to be burnt.
17. Are economizers to be used? State type and size employed.
18. If so, give the temperature of the feed water on entering the economizer and boiler respectively in ° F.
19. State draught at back of boiler and at base of chimney in inches w.g. With average load . With maximum load
20. Is mechanical draught to be used? If so, what type?
21. Give particulars of the firing squad used under present conditions.
22. Give internal diameter at base, internal diameter at top, and height of chimney stack, in feet.
23. What type of stoker is to be offered?

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16. This should give a description of the fuel, i.e. whether wood, peat, coal, coke, etc.; state average size of piece delivered or give trade name. State from which mine, etc., fuel is obtained, give chemical analysis showing percentage of hygroscopic water, percentage of ash, percentage of sulphur, and state calorific value of the fuel in B.Th.U. per lb.

21. The number of firemen employed per shift; the number of shifts worked and the length of each shift in hours should be stated.

23. Under-feed, over-feed, chain grate, shovel, etc.

## SUB-STATION, AUTOMATIC

1. Give particulars of the primary supply.
2. State nature of supply to be taken from the secondary side.
3. State capacity of the station required on the secondary side, in kW.
4. State size of unit preferred, in kW.
5. What type of unit is preferred ?
6. State whether time or voltage control of the station is required.
7. At what voltage on the secondary feeder bars is the set to cut in ?
8. What time lag is required before set cuts in, in seconds ?
9. At what load on the secondary bars is the set to cut out, in amps. ?
10. What time lag is required before set cuts out, in seconds ?
11. Is set to work in parallel with other plant ? Give particulars.
12. Give particulars of protection required.

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1. System, D.C., single-, two-, or three-phase ; two-, three- or four-wire ; voltage, frequency ; also give particulars of sets in central station, number and size in kW.

2. System, voltage and frequency.

5. Rotary convertor, motor-generator set, mercury-vapour convertor.

6. Time control means switching in at a predetermined time, and is sometimes to be preferred in railway substations.

In connection with this question it should also be stated whether distant control from the central station or another substation is also desired.

8. That is, how long is the voltage to remain at the figure given in answer to question 7, before the set cuts in ?

11. State size in kW., type of generator, and how driven, distance in yards from new substation and size of its feeders.

12. Complete protection should be provided for—

(*a*) *Overload.* If the demand is greater than the set can supply, set should not be cut in. (This might occur, due to some other parallel running set being shut down.)

(*b*) Faults on + or − side of any feeder. The particular feeder should be cut out without interference with any other circuit.

(*c*) Short circuit on the outers of any feeder. Same as (2).

13. Is the neutral wire earthed ? How ? Where ?
14. Give particulars of all out-going feeders from the sub-station.
15. Give sketch showing space available for set.

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(*d*) Starting set up against a fault.

The plant may be so arranged that if the set should be cut out, due to the operation of any relay, the starting gear will be locked and set cannot be again started up automatically till after examination by an inspector.

13. With or without resistance. At central or substation.

14. Number ; type, two- or three-wire ; load on each feeder in amps. ; setting of overload relays required.

## SUPERHEATER

1. State quantity of steam to be dealt with in lb. per hour.
2. What is the steam pressure in lb. per sq. in. abs. ?
3. What amount of superheat is required in ° F. ?
4. What type of superheater is required ?
5. Give size and type of boiler with which superheater is to be used.
6. State the calorific value of the fuel to be used in B.Th.U. per pound.
7. Will forced or natural draught be used ?
8. Give the amount of coal burnt per hour, in tons.
9. What is the gas temperature at point of flue where superheater is to be fixed, in ° F. ?
10. How much space is available for the superheater ?

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3. Instead of the amount of superheat required, the final temperatures of the steam in ° F. may be given.

4. Fixed in boiler flue or independently fired, with or without adjustment of the amount of superheat, etc.

5. This should state whether boiler is Lancashire, Babcock & Wilcox, etc., and maker's size.

7. In the case of an independently fired superheater, state draught available in flue where superheater will be connected.

8–9. Can only be given in the case of an existing boiler plant.

10. This should give the dimensions of the space available at the back of the boiler or between the boiler tubes. If possible, a sketch should be supplied with inquiry showing proposed situation for fixing superheater. This should also be done in the case of an independently fired superheater, if the available space is at all limited.

## SWITCH, AIR-BREAK

1. Give particulars of the supply on which switch will be used.
2. State number of poles required.
3. Give normal full load current which switch must carry, in amps.
4. Is switch to have slow or quick break ?
5. State what trips are to be fitted to the switch.
6. Are any of the trips to be fitted with time-lag ?
7. What type of switch is required ?
8. How is the switch to be operated ?
9. Is a L.T. supply available ? Give particulars.
10. Will the switch be frequently tripped ? State number of times per hour.
11. Is the switch to be interlocked with other apparatus ?
12. State what accessories are required with switch.

See B.S.S., Nos. 109, 110, 124, 126, 127, 130.

1. D.C., single-, two-, or three-phase, two-, three-, or four-wire ; voltage and frequency.

5. These may be overload, reverse current, no-voltage, or leakage trips. For overload trip, state range of overload at which it is to operate, and for leakage trip, percentage of leakage for which it will be set.

7. With front or back connections, for mounting on switchboard, pillar, or wall, for mounting in ironclad switchgear, etc.

8. Hand, with free or fixed handle, remote mechanical operation (in which case enclose a dimensioned sketch showing proposed layout, so that levers may be suitably arranged), remote electrical operation.

9. D.C. or A.C. voltage and frequency.

10. Where very frequent operation of the switch occurs (as in connection with cranes, etc.), the class of machinery with which the switch will be used should be fully detailed. If the switch is frequently opened under overload this should be stated.

11. If so, state whether electrically or mechanically and with what apparatus. If mechanically, give a dimensioned sketch of proposed arrangement.

12. With or without base (state whether slate, marble, etc., and its finish) ; enclosing cover (state also whether required watertight, dust-proof or explosive-proof) ; if to be supplied with dividing fillets between the poles ; indicating lamp ; cable-end boxes, tell-tale indicator, etc.

## SWITCH, BATTERY REGULATING

1. State type of switch required.
2. State form of switch preferred.
3. What is the voltage of the circuit to which the battery will be connected ?
4. What is the maximum discharge current to be carried by the switch ?
5. Will more than one cell be connected across contact ?
6. How is switch to be operated ?
7. Is a position indicator required ?
8. Where will the switch be erected ?
9. Enclose dimensioned sketch of space available.

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1. Single (cannot be used for discharging whilst battery is being charged).
Double (for simultaneous charge and discharge).
Treble, occasionally used to give more than one voltage to supply different feeding points.
2. Circular or straight contact path, choice is sometimes limited by current.
5. Will be usually fixed by voltage of the circuit, and current to be carried by the switch.
6. Hand, hand-wheel and chain, etc., electrically by push-button or by automatic voltage relay.
7. This may be fixed on switchboard and will indicate how many cells a.e charging or discharging.
8. In battery-room or in switch-house.

## SWITCH, OIL

1. State for what system the switch is required.
2. Give normal full-load current which switch is to carry, in amps.
3. State voltage and frequency of system on which the switch is to be used.
4. Give the total capacity of the system in which the switch operates in kVA.
5. Is any point of the system earthed ?
6. What trips are required ?
7. Is any time lag required with the overload and reverse power relays ?
8. Are charging contacts and resistances required ?
9. State system, voltage and frequency of any low voltage supply which is available.

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See B.S.S., Nos. 116, 148.

1. D.C., two- or three-wire ; single-, two-, (three- or four-wire) three-phase (three- or four-wire). It will be assumed that a three-pole switch can be used with a two-phase system. If a four-pole switch is required, this must be stated.

4. The normal full-load capacity of each of the machines in the station. together with type of prime mover, should be given, as it is possible for circumstances to be such that the switch may be called on to break the full load. This will to some extent depend on the relative position of the switch operating to the other switches on the system, to the distribution of the time lags on the relays, etc. In the case of substations, state the number and size of all feeders to it working in parallel. Also give kVA. capacity and ratio of transformation of any transformers connected between the switch and the feeders. In all cases of important switches, the fullest particulars of the station should be given. This should include particulars of any reactances used to limit current and where they are placed.

6. Are trips to be direct-acting or through relays ? These may be overload, no-volt, leakage, reverse power trips, or remote control coil. In the case of overload relays, state the range of overload adjustment required. The reverse power relays may operate a no-volt trip coil if no suitable low-tension supply is available, and in this case no time lag can be fitted. If a low-tension supply be available, the reverse power relays close a special coil on the switch which is operated from the low-tension supply. This trip can only be used on C.C. circuits and is usually set to operate at 25–50 per cent reverse power. A no-volt and reverse power trip cannot operate in conjunction unless the reverse trip opens the circuit of the no-volt coil. The leakage trip can be arranged to trip the switch on the occurrence of an unbalanced leakage on one phase. State percentage of leakage for which switch is to be set.

8. Only necessary in case of high-tension systems.

10. What type of switch is required ?
11. If mechanically operated, give a dimensioned sketch from which the levers can be arranged.
12. Are pilot lamps required ?
13. Is any temperature rise specified ?
14. Is switch for continuous or intermittent service ? If the latter, state the maximum number of times the switch will be operated per hour.
15. Is the switch to be interlocked with other apparatus ?
16. Is the switch to be provided with cable end boxes ?

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10. The switch may be for switchboard, wall, or pillar mounting, hand, remote mechanical control or remote electrical control.

14. It is here assumed that the switch will be broken under not more than normal full-load current. If the switch is likely to be operated frequently under overload this should be specifically pointed out.

15. If so, state whether electrically or mechanically and with what apparatus. If mechanically, give a dimensioned sketch showing proposed arrangement.

## SWITCHBOARD

1. State system to be controlled.
2. Give voltage and frequency of system.
3. What type of switchboard is required ?
4. What type of instrument is desired ?
5. What type of switch is desired ?
6. Give particulars of the trips and releases desired.
7. Give full particulars of each machine or circuit to be controlled.
8. What accessories are required ?
9. What system of line protection is to be used ?
10. Give dimensioned sketch of building in which the switchboard will be erected.
11. Are spare panels to be left for future extensions ? State how many.
12. Is the neutral point of system to be earthed ?

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See B.S.S., Nos. 158, 159, 160.

1. Whether C.C. ; single-, two-, or three-phase ; three- or four-wire.

3. Whether to be of panel, truck, desk or ironclad foolproof type, panels of slate, marble, iron, etc. For small boards, whether angle iron or pipe framework.

4. Whether round, sector, edgewise ; with or without illuminated scale ; front of board or sunk mounting ; recording or indicating ; moving coil, induction, moving iron, etc., whether to be on bracket. Specify any special instruments required, such as synchronizers, frequency indicators, leakage indicators, etc. State whether space has to be reserved for Tirrill regulator.

5. State whether air or oil ; to be mounted on front of board, back of board, or in cellar ; whether to be mechanically or electrically operated. In the case of oil switches enclose a data sheet.

6. Is switch to be provided with overload, reverse, or no-volt releases ; with or without time lag ; with or without indicating lamps ? In the case of A.C. circuits, is there a low-tension continuous current supply available for operating trips and releases ?

7. This should state kind of circuit to be controlled, generator, transformer, battery, converter, feeder (whether cable or transmission line), motor, electric furnace, etc., the power of each circuit to be controlled in kW. at a given power factor ; and maximum short circuit power which the switch might have to break. Whenever possible, give a line diagram of connections of the whole apparatus to be controlled by the board.

8. Clock, ornamentation, lamps over each panel, enclosing side doors, etc.

9. Merz McLellan, Merz Price, Merz Hunter, split conductor, etc.

10. The sketch should show the proposed layout of the machines together with the proposed position of the switchboard. The position of all columns, joists, girders, etc., and size of them should be shown. It is extremely important in all high-tension work that this sketch should be fully dimensioned.

12. State whether connected direct to earth or through a resistance.

# TACHOMETER

1. State speed to be measured in r.p.m. Maximum . .. Minimum...... .. Average
2. What diameter of dial is preferred ?
3. How is the tachometer to be driven ?
4. Is an indicating or integrating tachometer required ?
5. Is the instrument to be fitted with a maximum indicator ?
6. Is the instrument to be fitted with an electrical alarm ?

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3. By solid coupling, spring coupling, belt or rope drive, in which case state the diameter of the driving pulley and whether it is the speed of this pulley which has to be measured. If this pulley is on a countershaft, state ratio of speeds between countershaft and main shaft of which speed is required.
4. Or a combination of both. In the case of an integrating tachometer, is a five-, six-, or seven-figure meter required ?
6. Give limits at which alarm is to operate, i.e. for example, plus or minus 10 r.p.m.

The tachometer can also be supplied in an electrical form as an indicating or recording instrument. If this type is preferred, use data sheet for electrical measuring instrument and answer such questions as refer to the type of instrument, and also enclose this data sheet with answers to questions 1, 3, 5, 6.

## TANK, LIQUID

1. For what liquid is the tank required ?
2. State maximum quantity of liquid the tank is to hold, in gallons.
3. Is the tank to be under internal pressure ? Give particulars.
4. State temperature of the liquid as supplied to tank in ° F.
5. What type of tank is required ?
6. Of what material is it to be made ?
7. What type of joint is preferred ?
8. Is it to be made in sections for erection on site ?
9. State what finish is required.
10. Enclose dimensioned sketch showing position and size of manhole, pipe connections, etc.
11. Is steel tower to be provided ?
12. If so, state height in feet measured from ground level to underside of tank.
13. State what accessories are to be included.

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1. Water, oil, petrol, tar, chemicals, etc. If liquid has corrosive action on iron or steel, give particulars (name, concentration).

2. Or if size of tank is already fixed, state length, breadth, depth and gauge, or thickness of material to be used.

3. State pressure in lb. per sq. in. abs.

5. Cylindrical or rectangular, open or enclosed. Fixed or for transport purposes. In latter case, state whether for railway wagon or lorry, and how contents are to be taken from tank, syphoned, pumped, or blown out by compressed air. Give full dimensions of the wagon on which the tank is to be fixed.

6. Cast-iron or steel.

7. Riveted or welded.

9. Painted or galvanized.

10. Give particulars of the pipe connections to be provided.

11. If so, enclose data sheet for foundations.

13. Liquid-level indicator, safety valve, cleaning or blow-off cocks, etc.

## TESTING, METAL

1. State name of metal to be tested.
2. State purpose for which it is proposed to use metal.
3. Give full particulars of the previous treatment of the test piece supplied.
4. State exact locality of main article from which test piece has been taken.
5. State at which temperature the undermentioned tests are to be applied.
6. Is a chemical analysis of the metal required ?
7. State which of the following physical properties are to be tested and given—
   (*a*) Specific gravity.
   (*b*) Specific heat.
   (*c*) Coefficient of heat conductivity.
   (*d*) Coefficient of electrical conductivity.
   (*e*) Coefficient of expansion.
   (*f*) Limit of elasticity.
   (*g*) Ultimate strength under tensile, crushing, bending, shearing, or torsional stress.
8. Is the material to be tested under dynamic stresses ? Give particulars of the test required.

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See B.S.S., Nos. 18, 103, 131, 240.

The engineer making the test should be careful to express the units in which the results of the tests are given.

In the inquiry it should be specified that where standard test piece specifications exist, these must be employed in the tests. Where such do not exist, the engineer making the test should give dimensions and mode of preparation of the test piece used, or the inquirer should himself specify the form and dimensions.

2. This will enable the engineer to draw attention to any qualities of the material which, on test, he finds unsuitable for this purpose.

3. This is extremely important and should include: how the test piece was prepared (turning, grinding, polishing, etc.) ; whether it has been hot or cold drawn, extruded, cast (state how cast, particulars of mould, etc.) ; details of any heat treatment it has undergone, etc.

5. Or series of temperatures. This temperature may not be the same for each test. If not, specify for each test separately.

7. (*g*) State under which form of stress the ultimate strength is required.

8. (*a*) Tests by blows from drop hammer, pendulum hammer, etc. State

9. Is the hardness or temper to be tested? Give particulars of test preferred.
10. Is the material to be examined for resistance to corrosion?
11. Is a micro-photograph with report required?
12. Is the heat treatment of the metal to be studied?
13. Give details of any special technical tests which are to be carried out—
    (*a*) Bending.
    (*b*) Forging.
    (*c*) Rim formation.
    (*d*) Dome formation.
    (*e*) Welding.

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whether test is to produce a tensile, crushing, or bending stress, and whether test piece is to be with or without a notch.

Result of this test may be expressed as change in form produced by one blow of so many ft.-lb. energy or total amount of work done to break piece.

(*b*) Tests under repeated stress. State whether test is to be: (1) To destruction, or (2) For a given time under a specified change of stress.

Also state whether stresses are always to be in same direction, or alternately tension and compression.

Result may be expressed as number of changes of stress (stress should be given) required to produce destruction, or in case of (2) a comparison of its ultimate strength after this test with that of a similar, but untested, piece.

9. (*a*) Scratch test.

(*b*) Brinell ball test.

(*c*) Hole boring test (sometimes used in case of cast-iron, etc.).

10. State with what liquid (water, acid, alkali, etc.) concentration, temperature, etc., the test has to be carried out.

12. This will usually be done by finding temperatures of calesence and recalesence, and supply of corresponding temperature curves.

13. (*a*) Result usually expressed as the angle through which a bar may be bent without cracks appearing at the bend. State whether test piece is to be annealed or hardened.

(*b*) State what form of test is required—

(1) Spreading or lengthening by hammer blows.

(2) Flattening by hammer blows (rivet).

(3) Die test. Hammering a die through a hole in test piece till latter commences to split.

(4) Hole test. Forging a hole with a die.

(*c*) Rim formation. Forging a rim on a pipe or round a hole in a sheet of metal.

(*d*) Dome formation. Forging a dome (or bulge) of given size in a sheet or plate of the metal.

(*e*) State whether to be forge welded or electric welded.

(*f*) Magnetic.
(*g*) Quality of any protecting coating.

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(*f*) (1) Permeability.
(2) Hysteresis loss.
(3) Eddy current loss.
(4) Ageing properties.

(*g*) (1) Quantity of tin, zinc, enamel, etc., on specimen. This is not usually expressed as so many oz. per sq. in. or ft., but by special tests, such as dipping the plate, wire, etc., a certain number of times for a definite time into a solution of specified strength, etc.

(2) Same test as under 13(*a*), expressing angle at which coating commences to crack.

# TOOLS, MACHINE

1. What class of machine tool is desired ?
2. State size of machine required.
3. What type of machine tool is required ?
4. Is machine to be provided with hand or automatic feed ?
5. What type of chuck is to be employed ?
6. Give full description of the work to be done in the machine.

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See B.S.S., No. 122.

1. Lathe, miller, drilling machine, planer, slotter, shear, railway-wheel lathe, crank axle lathe, axle journal, returning and burnishing lathe, etc.

2. This can usually be done by giving maker's type and designation. When known, state height of centres or swing, distance between centres (lathes) ; maximum size and depth of hole, traverse, and radius of swing (drilling machine) ; width, depth, and length of table (planer) ; stroke (slotter) ; depth of throat (shear) ; length of blade and stroke (hack-saw machines) ; length of cross, length, and height of feed (boring machines and milling machines), etc. If this question cannot be answered with certainty, give particulars asked for in questions 6–10.

3. Combination (drilling and turning mill ; screwing and tapping machine ; drilling and tapping machine ; surfacing, boring, milling, drilling, and tapping machine).

Plain or universal.

Horizontal, vertical, radial, or a combination.

Hand-feed or automatic.

Internal or external, cylindrical or flat surface grinder.

Single- or multiple-spindle drilling machine.

Centre, surfacing, screwing, boring, turret, capstan, roughing, or finishing, etc., lathe, or a combination.

Cam lever or eccentric punch.

Three or four rollers for plate binders.

Roller or press type for bar straighteners.

With or without gap in bed for lathes.

Ordinary or quick change type for lathes.

Single, double, or triple machines (internal or external) for screwing machines, etc.

4. In latter case, are all the movements to be automatic ? If not, state which are required automatic.

In some cases the feeds are automatic but operated independently of the machine (hot or cold saws, shears, etc.). In this case, state what medium is to be used to operate the feeds, hydraulic, electric, or steam, and give particulars of supply.

In case of hydraulic supply, state pressure in lb. per sq. in. g. ; steam, give steam pressure in lb. per sq. in. abs., and temperature in ° F. ; electric : state system, voltage, and frequency.

5. Size ; ordinary or self-tightening ; two-, three-, or four-jaw ; universal or independent ; key or hand-operated ; inside, outside, or reversible jaws ; magnetic or non-magnetic (state D.C. voltage available) ; plain or taper, etc.

6. General work or mass production of one or two articles.

7. Give details as to the work to be done and size of material to be handled.
8. Give physical properties of the material to be worked.

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In combination machines, give particulars of each class of operation to be performed.

If work is of irregular shape and requires complicated movements, send sample or drawing.

Is work to be done on face, cylindrical surface, edge, etc., or duplicated on underside ?

In screw-cutting machines, state what type of screw is to be cut ; British standard, metric, etc.

In gear-cutting machines, what type of gear is to be cut, spur, bevel, helical worm, etc.

In edge planers, state whether end of plate has to be planed square with the side only or whether it is also necessary to be able to plane end at an angle to the side. State maximum angle with the side.

For benders, state whether to bend rings, plates, or straighten bars.

7. State how many tools will be cutting simultaneously, if more than one is to be used.

Maximum and minimum sizes of the work to be done or of the material to be handled should be given.

If these differ very considerably and are more or less exceptional, give average size as well.

In the case of combination machines, if both combinations are to operate together, state the maximum sizes which will be worked simultaneously. Ex.: combined shear and punch, give maximum thickness and maximum diameter of hole for punch which may be simultaneously done with the maximum length and maximum thickness on the shear.

Length, breadth, thickness, section (for angle, channel, and other sections), diameter, bore.

Diameter of tube and radius to which it is to be bent.

Diameter of cylinder to be rolled.

Number of holes to be drilled or punched at one time together with maximum diameter of hole ; minimum and maximum pitches and maximum thickness of plate in which these holes are to be made.

Type, pitch, and diameter of gear teeth to be cut.

Type, pitch, diameter, and length of screw to be cut.

Diameter and length of shaft (or bore) to be ground.

Size (section) and length of keyway to be cut.

If for tool, cutter or drill grinding, state whether wet or dry grinding and size and type of tool, cutter or drill.

State what finish is required in the case of polishing and buffing machines.

If cutting speeds or rate of feeds are specified, these should be stated together with full particulars of conditions under which these will be used.

8. This should state name of material, its tensile, crushing, bending, shearing, or torsional strength, whichever is most important for the work to be done ; its chemical composition ; its hardness on Brinel scale ; particulars of any heat treatment it has undergone ; whether it is cast, forged, drawn, rolled (hot or cold) ; whether castings have been pickled or sandblasted ; temperature in ° F. of material as worked (hot saws) and maximum temperature in ° F. which material must not exceed during operations if this is important.

9. State output required per hour.
10. State accuracy required.
11. Enclose dimensioned drawing or submit sample of work to be done.
12. State nature of drive required.
13. State what accessories are to be included.
14. State any special requirements desired on the machine.
15. Enclose dimensioned sketch for proposed layout.

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9. This applies generally to automatic machines on mass production, and should state number of a particular size of screw, nut, bolt, etc., required per hour.

10. State to what system of gauge limiting will be worked, what type of fit is required, or state tolerances, i.e. to how many thousandths of an inch or hundredths of a millimeter the work must be accurate. Also state to which surfaces or operations this accuracy is to apply.

11. This should show state and size of article before operations and, in the case of a drawing, all the operations to be performed, the finished dimensions and accuracy on each surface required.

12. Usually, only transmission or electric motor drive comes into question. In former case, state speed and size of any pulley available. In latter case, enclose a complete data sheet for each machine to be driven in the case of an individual drive. In the case of a group drive, give particulars of the machines in the group, and a sketch showing proposed layout. When electric drive is to be used, the machine tool manufacturer should be informed what make of motor is preferred, if any, so that he can allow for any structural modifications to his machine to take the motor. In the case of some machines the drive is special: see data sheet for planer, etc.

13. Fast or loose pulley; cone pulley; gear-box; automatic stops, state to what motions; pump for lubricating liquid; special attachments for holding tool, cutter, or drill; dividing heads; rack spacing and cutting attachment, vice; cranes or other lifting gear; hand screws or hydraulic clamps; guards.

14. Such as, ordinary, ball or roller bearings; quick return (for planers, hack-saw machines, etc.); relief on back stroke (hack-saw machines); more than one head on rail, with side head (for planer); revolving, tilting, or canting table (shaping, slotting and milling machines); with or without hollow spindle (lathe); fixed or sliding head (drilling machines); single or variable speed (reeling machines); rotary or stationary head (screwing machines); number of tools in tool holder (capstan lathe), etc.

15. This should show space available, proposed method of drive, arrangements for bringing material to and taking it away from the machine, etc.

# TOWER, COOLING

1. State quantity of circulating water to be cooled in gal. per hour.
2. Give maximum temperature of the circulating water on leaving the condenser in ° F.
3. State reduction in temperature required in ° F.
4. Give full particulars of atmospheric conditions where cooler will be erected.
5. What type of cooler is desired ?
6. Of what material is the cooler to be constructed ?
7. Is a natural or forced draught cooler preferred ?
8. Enclose dimensioned plan of site.

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2. Or water-cooling jacket of the engine, air compressor, etc.
4. This should include—
   Temperature of air—Maximum ........ .. ..............
   Minimum ... .. . .
   Average Annual ... .

and average annual humidity of air expressed as a percentage. Whenever possible, supply yearly charts.

5. (*a*) Open.
(*b*) Tower or chimney.
(*c*) Is water to be pumped to cooler, or is it allowed to flow by gravity to cooler from condenser, etc. ?

6. Wood, ferro-concrete, steel.

8. This should show proposed position of cooler with space available for it ; all pipe connections from condenser, etc., to cooler ; diameters and lengths of pipes ; and differences of level of condenser water inlet and outlet, measured from ground-level. It should also indicate any neighbouring buildings which might restrict free passage of wind across cooler.

This data sheet can be used for water-cooling plant for all classes of industrial purposes and, if type of cooler other than tower type is required, specify type in question 5.

No pumps or piping will be offered unless specially requested.

## TRACK, LIGHT RAILWAY

1. State length of track required in yards or miles.
2. What section of rail is preferred ?
3. State weight of rail required in lb. per yard.
4. State rail gauge desired, in feet.
5. Are steel or wooden sleepers to be used ?
6. Give distance in feet from centre to centre of sleepers.
7. Give maximum load in tons on each axle, and distance in feet between axles for the locomotive to be used on these rails.
8. Is any curved track required ? If so, give quantity required and radius of curvature, in feet.
9. How many branches with switches, and of what type, are required ?
10. How many plain crossings are required, and at what angle to main line ?
11. Is a turntable or weighing table required ? If so, state which, and give maximum length of wheel

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See B.S.S., Nos. 11A, 47, 47A, 64, 68, 104.

It is to be assumed that the track will be supplied complete ready for laying.

1. By track, is to be understood two parallel lines of rail complete. Double track will be four lines of rail. The length of track is required, not length of rail.

5. Steel sleepers are usually supplied complete with fixing clamps, etc., by the firm which supplies the rails. When wooden sleepers are to be used, only dog spikes will be supplied with the rails.

6. This is fixed by the maximum load to be carried. Therefore, data asked for in question 7 should always be given where possible. If this is not possible, the name of the firm supplying the locomotive, together with the locomotive number, etc., should be given to enable the necessary particulars to be obtained.

7. This data enables size of rail and distance between sleeper to be checked.

9. These may be right hand, left hand, symmetrical, or three-way ; if a double track is being used there may be in addition a single cross-over from one track to the other, right or left hand, a double cross-over at the same point between the two tracks, or a junction into the double line from right or left hand. These will all require switches. There may also be a crossing at any angle without switches. The number of each class of switch branch should be given. State class of switch required if there is any special preference, and also if guard rails are desired.

11. Data asked for, of course, only refer to the wagons, not locomotives.

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base in feet and maximum weight to be turned, in pounds.

12. Give particulars of fish plates required.
13. Send dimensioned map showing layout of all sidings, branches, crossings, etc.

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12. This should give section and number and size of bolts used. It is not necessary to give this data if the complete track is being inquired for, and is only desirable to enable resistance of the track to be calculated in the case of electric traction.

If points, crossings, branches, or curves are to be asked for separately, the following questions must be answered—

| | | |
|---|---|---|
| Branches . | Questions | 2–6, 9, 12. |
| Crossings . | ,, | 2–6, 10, 12. |
| Curves . | ,, | 2–6, 8, 12. |
| Turntable . | ,, | 2–4, 7, 11. |

## TRACTOR, ROAD

1. State what type of tractor is required.
2. State maximum net load to be pulled on level, in tons.
3. Give maximum incline up which tractor may be required to operate.
4. State maximum net load to be pulled up this incline.
5. State condition of the roads on which tractor will be used.
6. Give particulars of the fuel to be used.
7. Is tractor required to drive auxiliary machinery? Give particulars.
8. Is body to be suitable for tipping?
9. What type of wheel is required?
10. Is awning to be provided for driver?
11. If trailer is to be supplied, state type required.
12. Is trailer to be sprung?
13. State capacity of trailer required.

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1. Steam, paraffin, or petrol engine.

2–4. This includes load in any trailer attached. In case of a trailer, state net weight of trailer alone and net weight of load alone.

It is here assumed that roads are in good condition. If roads are in very bad condition, or loads have to be drawn over ploughed land or prairie, this should be distinctly stated.

6. Name, coal, coke, wood; size; calorific value in B.Th.U. per lb. If tractor is to be electrically driven, state average distance to be travelled per day.

7. Such as threshing machinery, pump, etc. If so, it will be necessary to supply fly-wheel type pulley and governing gear.

8. Side or end tipping, hand or automatic.

9. Flat steel wheel, ordinary iron wheel, rubber-tyred wheel, caterpillar tractor.

10. It may also be carried over whole engine if desired.

11. State class of goods the trailer is to carry. If a trailer is required for special work, such as carrying boilers, structural steel, large castings, tanks for oil, water, chemicals, etc. (see also separate data sheet), a drawing should be sent. If ordinary trailer is required, state whether to have removable sides or end, let-down sides and end, whether whole body is to be tippable and whether to side or end, etc.

12. Or supplied rigid. This will depend to some extent on the work to be done.

13. That is, load it is to carry in tons.

This data sheet may also be used for trailer alone (questions 5, 8, 11–13), but it is then necessary to state height of drawbar socket on the tractor.

# TRANSFORMER

1. On what system is the transformer to be used ?
2. What output is required from the transformer in kVA. ?
3. Describe nature of the load on the transformer.
4. State frequency of circuit.
5. Give ratio of transformation required.
6. Is a straight or auto-transformer required ?
7. What type of transformer is desired ?
8. Is artificial cooling required ? If so, state whether air or water cooling is preferred.
9. Give particulars of air or water supply available for this purpose.
10. Is the transformer to be erected unprotected in the open air ?
11. What connection of high-tension coils is required ?
12. What connection of low-tension coils is required ?

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See B.S.S., No. 148.

1. Single-, two- or three-phase, or transformation from two- to three-phase.

3. This should state whether transformer is for a pure power load, pure lighting load, or a mixture of power and lighting. In the case of transformers for use with rotary converters and electric furnaces, state the amount of reactance desired in transformer.

5. If the answer to this question is given as a ratio (for example, 4 : 1), then the high-tension voltage must also be given. It should also be stated whether this ratio is to be obtained at no-load, full non-inductive load, or full inductive load. If transformer is to be used for testing purposes, state voltage range desired, number of steps and whether it is necessary to effect these steps without breaking the circuit.

6. Auto-transformers are not so satisfactory as transformers with double windings, and are only to be recommended when the ratio of transformation does not exceed 4 : 1.

7. Natural air-cooled or oil-cooled.

8. This will depend on the size of the transformer and the situation in which it is to be used. Forced air-blast cooling or water-cooling of the insulation oil may be employed.

9. This should include the temperature in ° F. of the incoming air or water, the quantity in gallons per minute or cub. ft. per minute available for cooling, and the pressure in inches w.g. of the supply.

11–12. These may be answered by stating the group letter to which the transformer connections belong, or by giving small sketches showing relations of primary and secondary potentials.

13. Are high-tension tappings required, and if so, for what voltages ?
14. Are these tappings to be brought to terminals inside or outside the transformer case ?
15. Will the low-tension neutral point of the transformer be connected to the system ?
16. If so, will the phases be unequally loaded ? State approximate load on each phase.
17. Is the transformer to work in parallel with others ?
18. If so, give output in kVA., high- or low-tension voltages at no-load, short-circuit voltage and type of coil connection used, for each transformer with which it works in parallel.
19. Will the transformers with which it works in parallel be in the same building, or at various points on a transmission line ?
20. Will the transformer be required to operate in a reverse direction ?
21. Can one pole of the transformer be earthed ?
22. State overload capacity required.
23. State maximum temperature rise allowable.

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13. Tappings where required are usually made on the high-tension side, but they can also be provided on the low-tension side if the latter voltage is not too low.

18. For satisfactory parallel working, the transformation ratio at no-load, short-circuit voltage, and method of coil connection must be the same for all transformers. By parallel operation is understood the parallel connection of both high-tension and low-tension sides of several transformers at the same time. If only the high-tension sides are parallel connected, but the low-tension sides work on separate circuits, the transformers do not work in parallel and equality of the above ratios is not necessary. When giving the short-circuit voltage it should be stated whether this was taken with transformer hot or cold. (Small variations in the short-circuit voltage can be compensated.) Satisfactory parallel working will not be obtained if the ratio of the outputs of the smallest to the largest transformer exceeds ca. 1 : 5.

19. If the transformers which are to work in parallel are in the same central or substation, the no-load transformation ratios must exactly agree ; if they are separated by a length of transmission line a certain amount of deviation is allowable, depending on the length of line between the transformers. Therefore, state approximate length of line in yards between the transformers.

21. This very considerably reduces the cost in high-tension testing transformers.

24. State any special tests required.
25. Shall transformer case be provided with rollers ?
26. What accessories are required ?

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25. If transport rollers are required, state whether the transformer is to be moved parallel or at right angles to the side where the connections are led out.

26. Fuses, thermometer, oil gauge, earth shield, state earthing device, etc.

## TRANSFORMER, INSTRUMENT

1. State system, voltage, and frequency of supply.
2. What form of transformer is desired ?
3. What type of transformer is required ?
4. State ratio of transformation necessary.
5. What type of instrument will be connected on secondary side ?
6. State number of instruments to be connected.
7. State total volt-ampere capacity of all the instruments to be connected.

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See B.S.S., No. 81.

1. In two- and three-phase circuits, single-phase transformers will be offered unless two- or three-phase transformers are specifically asked for.

2. Air- or oil-cooled ; in iron cases run in solid with compound ; bus-bar type ; slip over cable type ; portable or fixed pattern ; for cellular, cubical, or truck gear ; for wall mounting or floor fixing. Twin transformers with two secondary windings, one winding being used for indicating instruments and protective devices and the other for integrating instruments.

3. Current or voltage transformer.

4. Secondary side is usually wound for 5 amp., for special protective work sometimes 2, 9, or 8·66 amp., and 110–220 volts, depending on instruments to be used. This may be given as ratio primary amp./secondary amp. for current transformers ; primary voltage/secondary voltage for potential transformers ; or primary turns/secondary turns for protective transformers.

5. Electro-magnetic, induction, etc., and state also whether ammeter, voltmeter, wattmeter, electricity meter, relay and type of relay, trip coil, etc. In the case of transformers required for protection work, specify the system of protection to be used, as this may necessitate transformers with self-balance, two or more primary windings, or special adjustable air gaps.

7. If this is not known it is advisable to specify questions 5 and 6 ; number, type, size, and make of each type of instrument it is proposed to connect to the transformer. The following figures may be of some assistance: Load taken by following instruments in volt-amp.—

*Current Transformers*—

| | |
|---|---|
| Moving iron ammeter, power factor indicator, indicating wattmeter integrating wattmeter | 1 |
| Induction ammeter, recording instruments | 6 |
| Overload relay | 12 |
| Overload coil | 40 |

*Voltage Transformers*—

| | |
|---|---|
| Moving iron voltmeter | 1 |
| Wattmeter and synchronizer | 13 |
| Integrating wattmeter | 14 |
| Reverse relay | 12 |
| Indicating wattmeter | 20 |
| No-volt coil | 30 |

8. Give voltage regulation required in the case of potential transformers.
9. Is the neutral point to be available ?
10. Is transformer to be provided with fuses ?

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8. Usually 1 per cent.
9. State whether this is to be brought out on the high-tension or low-tension side, or on both.
10. Only provided as a rule in the case of potential transformers.

## TRANSPORTER

1. Give full particulars of the material to be handled.
2. State quantity of material to be dealt with in tons per hour. Maximum . . ...... Average .... . ...
3. Into what receptacle is the material to be discharged ?
4. If material is to be stacked, give particulars of stack.
5. State maximum horizontal distance that material is to be conveyed, in feet.
6. State maximum height material is to be lifted, in feet.
7. State speeds of operation required in feet per minute.
8. What form of lifting attachment is preferred ?
9. Is an automatic weighing machine to be included ?
10. Give particulars of electricity supply available.
11. Is track to be included ?
12. Enclose dimensioned sketch showing proposed layout.

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See also data sheets for ship discharging plant, conveyor, elevator, sack unloader.

1. Name, coal, grain, sacks, boxes, etc., weight in lb. per cub. ft., dimensions of largest piece to be handled, wet or dry.

2. It is also advisable to state quantity to be handled per day, together with number of working hours.

3. To dump, to stack, into vessel, railway truck, etc.

4. Maximum dimensions of stack are required.

7. This is more or less fixed by question 2, and choice should be left to the maker.

8. Hook, grab, or bale.

10. System, voltage, and frequency.

11. Only applies to telpher transporters. State height of track required, and indicate all obstructions to be cleared on dimensioned sketch.

12. This should show all points of charge and discharge, obstructions to be cleared, position where supports may be placed, length of transporter beam which must be hinged, etc., length, height, and route of track if already in existence.

## TRAP, STEAM

1. State quantity of condensed steam to be drained in lb. per hour.
2. Give length in feet, and diameter and thickness of steam pipe, in inches, to be drained.
3. State type, nature and thickness, in inches, of non-conducting cover used on the steam pipe.
4. What is the steam pressure in lb. per sq. in. abs. and temperature in ° F. ?
5. State number of points to be drained by one trap.
6. Give the maximum height in feet from the lowest steam pipe drained to the top of the boilers.
7. Give dimensioned sketch showing layout of piping, position of boilers, and proposed position of steam traps.

---

1. If this cannot be given, the particulars asked for in 2 and 3 should be given for each section of pipe to be drained. It is important to state also whether flanges are covered or not. In the case of apparatus to be drained, such as dryers, etc., the dimensions should be given which will enable the exposed radiating surface to be calculated. In this case, question 3 must also be answered.

5. This is necessary in the case of a multiple trap, collecting drainage from several points.

6. This is only necessary if a special trap returning condensed steam direct to the boilers is to be used. If this is not answered it will be assumed that trap will discharge at atmospheric pressure at some point below the trap. If it is to discharge into a return pipe common to other traps, this should be stated.

## TRUCK, ELECTRICAL INDUSTRIAL

1. State size of truck required.
2. Where will the truck be used ?
3. Give particulars of the conditions of floor or road.
4. State amount of any inclines up which truck must take load.
5. What type of truck is preferred ?
6. Are battery-charging arrangements available ? Give particulars.

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1. Express as load the truck is to carry in tons. Speed is usually chosen as 5 miles per hour on level. It is also useful to give some indication of the class of material to be handled, and the number of working hours per day.
2. Indoors or outdoors.
4. Gradient as a percentage and length in yards. It will be assumed that maximum load will be carried up this gradient.
5. Three- or four-wheel type.
6. If not, enclose data sheet for accumulator charging station.

## TURBINE, STEAM

1. State b.h.p. required at the coupling. Normal . ............ .....Maximum.... . .
2. Give steam pressure at turbine stop valve in lb. per sq. in. abs.
3. Give steam temperature at turbine stop valve in ° F.
4. State vacuum required at turbine exhaust flange at full load.
5. What is the exhaust steam pressure at turbine stop valve in lb. per sq. in. abs. ?
6. What quantity of exhaust steam is available in lb. per hour ?
7. Will a low pressure steam accumulator be provided?
8. If so, give range of exhaust steam pressure at turbine stop valve.
9. If not, what is the maximum length of pause in the working of the engines from which the exhaust steam is obtained ?

---

See B.S.S., No. 132.

1. It is unusual to purchase turbines by themselves. They are more generally ordered complete with electric generator or compressor, etc., and treated as a single unit. In this case, in addition to giving the answers to the relevant questions above, it will be necessary to answer the questions on the data sheets for electric generators, compressors, etc.

2–3. Apply to live steam and mixed-pressure turbines.

5–9. Apply to exhaust and mixed-pressure turbines.

10–13. Apply to reducing turbines.

1, 4, 14–19. Apply to all.

4. Need not be answered if turbine makers are also to supply condenser, in which case enclose completed data sheet for condenser. This information is to be supplied to the inquirer by the firm offering the turbine if a condenser is not included in their tender and the inquirer proposes obtaining a quotation for a condenser elsewhere. If an existing condenser is available and the inquirer states the vacuum he can obtain from it, he must also state the maximum quantity of steam in lb. per hour which the existing condenser can deal with and still maintain the specified vacuum. The vacuum should be preferably expressed as a percentage.

5. The average exhaust steam pressure should be given.

8. Should be given as $\pm$ ........ lb. per sq. in. abs.

9. Should be given in seconds.

10. State pressure required for the heating steam in lb. per sq. in. abs.
11. What is the maximum quantity of heating steam required in lb. per hour? Maximum.... ........ Minimum ..........
12. Will there be long intervals when no heating steam will be required?
13. State maximum load in b.h.p. required during these intervals.
14. State at what load the most economical steam consumption is desired.
15. Give particulars of the load on the turbine.
16. State speed of turbine in r.p.m.
17. Is an automatic exhaust valve to be provided?
18. If so, is a specified output required from the turbine when running to atmosphere?
19. What accessories shall be included?

---

10. It is assumed this pressure remains constant. If it may vary with the load, state this fact.

11. In answering this question it is assumed that heating steam will be required continuously, but that the amount taken will range between a maximum and a minimum.

12. The length of the interval when no heating steam is required should be given.

13. In the case of reducing or back-pressure turbines, the turbine is supplying a load as well as giving heating steam. Consequently, it is of importance to specify the maximum load which might be required when no heating is being taken.

15. State whether for land or marine purposes, to drive generator, compressor, etc., whether load is steady or subject to sudden variations, whether plant is to run day and night (state length of longest continuous run).

17–18. These questions usually only occur in connection with turbo-generators. The output which a turbine will give when exhausting to atmosphere is about 75 per cent full load, but this will depend on the steam conditions. The output required should be stated in kW.

19. This may include oil cooler for lubricating oil, water separator, registering pressure and vacuum gauges, tachometer, thermometers, etc.

# TURBINE, WATER

1. State continuous b.h.p. required at coupling.
2. State overload capacity required.
3. Give speed of turbine required in r.p.m.
4. What type of turbine is preferred ?
5. State form of turbine preferred.
6. State how water is to be brought into turbine house.
7. Give net head of water available at turbine floor level in feet.
8. Give suction head available, measured from turbine house floor level, in feet.
9. If head is variable, state range in feet.

---

It is here assumed that the development of the water power, that is, the design of the dam, pipe line, etc., has already been done and that, consequently, the quantity of water available for power production is known. It is further assumed that the quantity of water is continuously available, and is sufficient to meet the maximum load required. If this should not be the case, state minimum quantity of water which might occur and, if rapid alterations in the supply to the turbine are liable to take place, particular attention should be drawn to this fact.

3. This is usually fixed by form of drive, direct-coupled, etc., and machine to be driven (electric generator, etc.).

4. Kaplan, Blanki, Francis, Pelton. Choice is not completely free, but following will be a rough guide—

| | | |
|---|---|---|
| Head up to | 30 ft. | Francis: open type, horizontal or vertical shaft, single or double wheel. Kaplan. |
| ,, ,, | 30–150 ft. | Francis: enclosed type, horizontal shaft, one or more wheels, vertical shaft, one wheel. Blanki. |
| ,, ,, | 150–600 ft. | Francis: enclosed type, horizontal shaft. (In very large sizes may also be made with vertical shaft.) |
| ,, ,, | 3,000 ft. | Pelton. |

5. Horizontal or vertical shaft; open (i.e. runner built into ferro-concrete chamber); enclosed in its own casing; spiral casing or boiler casing.

6. (*a*) From above centre line of turbine; (*b*) along turbine axis; (*c*) from below centre line of turbine. Choice depends to some extent on type, size, and arrangement of turbine.

7. This is the head available less all losses occurring in pipe line, valves, etc.

8. This is drop measured from turbine floor-level to lowest water-level in the tail race; no allowance should be made for friction losses. This drop should not exceed ca. 20 ft., but this will depend on the altitude at which the turbine is erected.

9. State variation in height for both main head and suction head separately. These variations will usually occur together.

10. At what head is continuous normal output to be given ?
11. Is the suction-pipe to be in steel or ferro-concrete ?
12. What type of speed regulation is required ?
13. Is the speed for which the regulator is set to be electrically controlled from switchboard ?
14. Is the regulator to be provided with automatic vane-opening limiter ?
15. If so, how is it to be operated ?
16. What is the turbine to drive ?
17. State nature of drive preferred.
18. Give particulars of any accessories required.
19. Enclose a dimensioned sketch showing proposed layout.

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10. In this instance, state only net main head, but clearly mention this in the inquiry.

12. Hand or automatic, or combination ; compressed air system or gear wheel pump system.

14. This should be used if water quantity varies rapidly.

15. May be controlled by float and chain, pneumatically or electrically ; choice may to some extent be affected by the proposed layout. If pneumatically, state air pressure available in lb. per sq. in. ; if electrically, state system, voltage and frequency of supply available.

16. Transmission shaft or electric generator ; in latter case state whether A.C. or D.C. If generator is to be included, enclose data sheet. The manufacturer of the turbine should also be asked to state the runaway speed for which the generator should be designed.

17. Belt or rope, gear, direct-coupled. Choice is not always entirely free, but will depend on what is to be driven.

18. Valves, tachometer, head indicator, etc.

19. This should show proposed layout in turbine house itself. The length and diameter of pipes, impounding dam, suction head, and site of turbine house should also be shown, but on a separate sketch and to a smaller scale, if necessary.

## UNLOADER, SACK

1. State quantity of material to be dealt with in lb. per hour. Average............ Maximum ..............
2. State weight of each sack in pounds.
3. Give description of sack or package to be handled.
4. State whether the unloader is for ship or truck discharging.
5. If for ship work, state variation in tides and distance of lowest water level from quay surface, both in feet.
6. Are the sacks to be discharged into a truck or a warehouse ?
7. State maximum vertical distance sacks are to be conveyed, measured from quay surface in feet.
8. State maximum horizontal distance sacks are to be conveyed, measured from quay edge in feet.
9. State size of ship to be unloaded.
10. How is unloader to be driven ?
11. Give dimensioned sketch showing proposed layout of unloader.

---

1. State also the number of hours the maximum demand is likely to last.

3. This should include the dimensions of the largest sized package to be handled.

9. State size of ship in tons, to enable an approximate figure to be fixed for height of lift in ship itself.

10. May be driven from an existing line shaft ; in which case the speed, diameter of pulley, direction of rotation and position relative to the unloader of the proposed drive should be stated. If electric drive is desired, the system, voltage, and frequency of the supply available should be stated.

# VALVE, LIQUID

1. What liquid is to be passed ?
2. For what purpose is the valve required ?
3. What form of valve is required ?
4. What type of valve is preferred ?
5. State the internal liquid pressure which the valve will normally have to withstand in lb. per sq. in. abs.
6. State the temperature of the liquid in ° F.
7. Give size of valve required, diameter in inches.
8. What form of joint is required ?
9. Is the valve to be electrically or hydraulically operated ?
10. Is the valve to be hand operated, if so, what form of gear is desired ?
11. Enclose dimensioned sketch showing proposed layout.

---

1. Water, oil, acid, brine, ammonia, sewage. If the liquid is likely to have any chemical effect on the material of the valve, give an analysis of the liquid ; or contains grit, sand, etc., likely to prevent accurate closing of the valve ; attention should be drawn to these facts.

2. Cut-off, non-return, etc.

3. Vertical or horizontal passage.

4. Globe or gate.

5. This should state normal working pressure. Attention should be drawn to cases where the valve may have to stand considerable excess pressures, due to water-hammer (in hydro-electric pipe line for instance).

8. Screw, flange, spigot, and socket, etc. The choice of joint will depend on pressure, temperature, and liquid. If flanges are special, give full particulars with sketch.

9. If electrically, state system, voltage and frequency. If hydraulically, state pressure in lb. per sq. in. abs.

10. This may be by means of spur or worm gearing, universal joints, chains, etc., from above or below, vertical or horizontal or inclined, in conjunction with hand-wheels. If floor standards are required to carry the hand-wheels, this should be indicated. For small valves a lever may be used in place of a wheel. Small valves may also be had for operation with key to make them foolproof.

11. The sketch should show exact proposed layout of piping, valves, and hand-wheels.

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## VALVE, STEAM OR GAS

1. State type of valve required.
2. For what purpose is the valve required ?
3. State what form of valve is desired.
4. Give steam pressure in lb. per sq. in. abs.
5. Give steam temperature in ° F.
6. State size of valve required. Diameter in inches.
7. Is a by-pass valve desired ?
8. Is any special finish required ?
9. What form of gearing is required for operating the valve ? Enclose dimensioned sketch.
10. Is the valve to be electrically or hydraulically operated ?
11. If the valve is required for a gas other than steam, give particulars of the gas to be controlled.

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1. Globe or gate.

2. Throttle, check, non-return, blow-off, etc.

3. Horizontal, vertical, or angle steam passage. What type of connection is preferred, screw or flange ? Screw connections are, as a rule, only provided up to 12 in. diameter, and for pressures not exceeding 250 lb. per sq. in. g. The material of which the valve body is to be made should be stated, if any special desire exists. Bronze bodies are not usually made in sizes exceeding 4 in., nor for pressures exceeding 250 lb. per sq. in. g. Cast-iron may be used with saturated steam up to 250 lb. per sq. in. g. For saturated steam over this pressure, and for superheated steam of all pressures, use steel. If special form of flanges is desired, particulars should be enclosed with sketch of same. In the case of check or non-return valves, state whether they are to be combined.

7. Bypasses should be provided on all valves for pressures over 125 lb. per sq. in. g., and sizes over 16 in. ; for pressures over 200 lb. per sq. in. g., and sizes above 6 in. ; for pressures over 400 lb. per sq. in. g., and sizes over 4 in.

8. Valves are usually supplied with rough body and finished fittings ; but in some cases bodies are finished all over and hand-wheel nickel-plated.

9. This may be by means of spur or worm gearing, universal joints, chains, etc., from above or below, vertical, horizontal or inclined, in conjunction with hand-wheels. If floor standards are required to carry the hand-wheels, this should be indicated. For small valves, a lever may be used in place of a wheel. Small valves may also be had for operation with key to make them foolproof. The sketch should show exact proposed layout of piping, valves, and hand-wheels.

10. If electrically, state system, voltage, and frequency. If hydraulically, state pressure in lb. per sq. in. abs.

11. Name, chlorine, coal gas, blast furnace gas, etc.

State also whether gas is moist (give percentage of moisture) and contains much dust.

12. In case of reducing valve, state lower pressure required in lb. per sq. in. abs.
13. State pressure at which valve is to blow off, lb. per sq. in. abs.

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13. Required for atmospheric relief valves and safety valve. State also whether blow-off pressure is to be adjustable, and whether dash pots are to be provided (internal or external pattern).

## WAGON, LIGHT RAILWAY

1. State capacity of wagons required, in pounds.
2. What is the road gauge clear between rails, in feet ?
3. Are there any limits to the dimensions of the wagon. If so, give particulars.
4. Give full particulars of the material to be conveyed.
5. How are the wagons to be hauled ?
6. Give particulars of the method employed for filling the wagons.
7. What method of emptying the wagons is desired ?
8. What is the smallest radius of curvature round which wagons will be hauled, in feet ?
9. What type of buffer, coupling, and brake is required ?
10. Give particulars of any existing wagons in use.
11. State type of construction required.

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See B.S.S., No. 24.

3. That is, is the length, width, height, or weight of the wagon restricted to within certain figures ?

4. Earth, cement, sand, coal, sugar cane, bamboos, timber, barrels, etc. Also give weight per cub. ft. in lb., and dimensions of the largest piece to be carried.

5. Hand, horse, or locomotive haulage, endless rope overhead, underneath, or at side of the wagon.

6. By hand with shovel, from concrete mixer, from steam shovel by overhead shoot, etc.

7. Double-side tip, double-side discharge, end-tip, bottom discharge, or all-round tip. Is the body to be lifted by a crane from the tip wagon ?

9. Buffers may be central or side, spring or non-spring ; in the central type the buffer may be combined with the coupling. Couplings may be hook and chain or hook and screw tightening gear ; brakes may be lever or screw, acting on two or four wheels.

10. These should include net and gross weights ; details of buffers and couplings ; height of the centre line of the buffer above the rail head in inches ; for each type of wagon employed.

11. All wood, all steel, or combined. This choice is not absolutely free, but depends on work wagon has to do.

## WEIGHBRIDGE

1. State maximum load to be recorded in tons.
2. State gauge of rails.
3. State width of platform required in feet.
4. State length of platform required in feet.
5. Is weighbridge to be used for both rail and road traffic ?
6. State maximum load which may pass over bridge, but which is not to be weighed.
7. Is cabin for recording machinery and checker to be provided ?

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3. Only necessary when road traffic is to be weighed.
5. In this case, state whether lorry or horse traffic, and in addition to answer to question 1, also give maximum load to be recorded in the case of the road traffic.
6. Such as a locomotive. In addition to the maximum load in tons, also state wheel base in feet and load per axle.

## WELDER, ELECTRIC ARC

1. What quality of material is to be welded ?
2. State dimensions of the piece to be welded.
   Maximum.. ......... ... Average......... .. ..
3. State maximum current to be supplied to the electrode in amps.
4. What type of electrode is to be employed ?
5. State whether hand or automatic feed is preferred.
6. Give particulars of supply available.
7. Is a special generator to be supplied ? If so, state how it is to be driven.
8. Will more than one welder be fed from this generator ?
9. Are there any regulations affecting the use of the welder ?

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1. High carbon steel, alloy steel, cast-iron, copper alloys, etc. Whenever possible, give chemical composition of the material.

2. Breadth and depth of section and weight of piece in lb. Give also general description of class of work to be done. Ex.: Welding sheets, plates, bars, filling in blow-holes in castings, mending cracks, etc.

3. This is mainly governed by 1 and 2. Should be given if known. Usual sizes run from 60–200 amp.

4. Bare iron or flux covered.

6. System, D.C., single-, two- or three-phase ; voltage and frequency. A.C. welders require 45–60 volts, and D.C. welders from 75–90 volts, at electrode.

7. From transmission line shafting (state speed in r.p.m.) ; by electric motor ; by paraffin, petrol, etc., engine. In latter cases the generator and motor or engine can be supplied as a complete self-contained portable unit, if so desired.

9. Such, for instance, as a regulation by the electricity supply authorities specifying maximum out-of-balance current allowable. If the welder is to be fed from a three-phase system and more than one welder is in use, it is possible to partially balance the currents taken. In such a case, therefore, state number and size of all welders already in use, and how supplied with current.

## WELDER, ELECTRIC, RESISTANCE

1. Give a general description of the article to be welded.
2. What are the dimensions of the largest piece in in. ?
3. What material is to be welded.
4. State thickness of material or diameter of rod to be welded, in inches.
5. What is the daily output required ? Number of articles.... ... ...
6. In how many working hours is this output to be obtained ?
7. What type of weld is desired ?
8. If point weld, give pitch of points in inches.
9. If butt weld, is the diameter at the joint to be reduced to normal ?
10. If seam weld, what overlap is required, and must the joint be watertight ?
11. State system, voltage, and frequency of supply available.
12. Is supply from a central station or private ?
13. If the system is polyphase, what is the maximum unbalanced single-phase load in kVA. allowable on one phase ?
14. If it is necessary to supply a special generator, how will it be driven ?
15. Send samples of the articles to be welded.

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1. It is desirable to keep the pieces as near the same size as possible in order to obtain the maximum output from the apparatus ; consequently, if more than one size is to be welded it may pay to have several machines, one for each size. This will depend on the number of each size of article to be handled. Hence the answer to question 5 should give the number of each article per day.

3. In the case of alloys, such as brass, the chemical analysis thould be given if this is known. If steel, say whether hard or soft, whether black or galvanized.

7. Butt, point, or seam.

12. If the supply is private, give particulars of the generators, number, rated capacity of each, and normal full load on station.

14. By belt, direct-coupled, etc. State speed in r.p.m. at which generator should run.

15. Several samples of each article should be sent to enable exhaustive tests to be made, and the daily output required of each type, as asked in question 5, indicated on the sample.

## WINCH

1. State maximum pull to be exerted on rope in pounds.
2. State speed of hauling required in feet per minute.
3. Give particulars of the class of work it will have to handle.
4. Is a portable winch required ?
5. Is rope drum to be provided ? If so, state maximum length of rope it is to take in feet.
6. How is winch to be driven ?
7. Give particulars of air, electric, or steam supply available.

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3. For ship work, contractors' work, use in docks, etc.
6. By air, steam, or electricity.
7. For air, state air pressure available in lb. per sq. in. g. ; for steam pressure in lb. per sq. in. abs., and temperature in ° F. at winch stop valve ; for electricity, system, voltage and frequency ; it is also advisable to enclose data sheet for motor.

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